FOSS MARITIME CO./BRIX MARITIME CO.
CSM Site Summary – Appendix A-4

FOSS MARITIME CO./BRIX MARITIME CO.

Oregon DEQ ECSI #: 2364
9030 NW St. Helens Road
DEQ Site Mgr: Dana Bayuk
Latitude: 45.5877°
Longitude: -122.7713°
Township/Range/Section: 1N/1W/11

River Mile: 5.7 West bank

LWG Member ☐ Yes ☒ No

Upland Analytical Data Status: ☐ Electronic Data Available ☒ Hardcopies only

1. SUMMARY OF POTENTIAL CONTAMINANT TRANSPORT PATHWAYS TO THE RIVER

The current understanding of the transport mechanism of contaminants from the uplands portions of the Foss Maritime Company/Brix Maritime Company (Brix) site to the river is summarized in this section and Table 1, and supported in the following sections.

1.1. Overland Transport

Overland transport of contaminated soil is minimized by the presence of pavement or buildings, which cover the entire Brix site, and of riprap that armors the riverbank (Anchor and HAI 2000). However, overland transport of contaminants released to surface pavement during site operations may be possible. Possible spills in the drum storage area or from the utility-owned transformers may be sources of contaminants that could be transported by overland flow (sheet flow) to the river.

1.2. Riverbank Erosion

Erosion of the riverbank is reduced by the presence of riprap armoring.

1.3. Groundwater

The shallow aquifer discharges to the river along the top of the silt aquitard, and is visible at the river's edge during low river stage. Releases of petroleum hydrocarbons have created a dissolved plume beneath the site (with occasional measurable NAPL present). A historic natural drainage feature in the southern half of the site may locally influence shallow groundwater flow directions in this part of the site. Low level hydrocarbon constituents have been detected in the downgradient-near river monitoring well (MW-4).

1.4. Direct Discharge (Overwater Activities and Stormwater/Wastewater Systems)

Overwater activities at the Brix site include maintenance activities performed at the covered barge permanently moored at the facility dock. Several documented releases have occurred to the river at the site, both from maintenance activities and discharges from moored vessels (Anchor and HAI 2000).

Stormwater drains through five catch basins on the site that discharge through private outfalls to the Willamette River.

1.5. Relationship of Upland Sources to River Sediments

See Final CSM Update.

1.6. Sediment Transport

The Brix site is located on the west side of the river at approximately RM 5.7. This is within the relatively narrow river reach from RM 5 to 7 that is characterized as a transport/non-depositional zone based on the site physical information compiled in the Programmatic Work Plan (Integral et al. 2004). The Sediment Trend Analysis® results indicate that sediment movement along this side of the river alternates between net accretion and net deposition, transitioning to dynamic equilibrium in the center and east of the channel. The measured bathymetric changes over the 25-month period from January 2002 through February 2004 (Integral and DEA 2004) show a complex mosaic of no change and sediment accretion and scour on the order of 1 foot in extent in the nearshore area around the site's dock structures above the –15 foot NAVD88 contour. From the –15 foot NAVD88 contour to full channel depth, the riverbed shows no measurable elevation change. In the center of main channel offshore of the site, areas of small-scour and no change predominate and are interspersed.

2. CSM SITE SUMMARY REVISIONS

Date of Last Revision: October 10, 2005 (based primarily on information obtained prior to September 15, 2004)

3. PROJECT STATUS

Activity		Date(s)/Comments
PA/XPA	☒	XPA (Anchor and HAI 2000); Sampling to support the XPA was performed in May-June 2001.
RI	☒	RI Work Plan (Anchor 2003) submitted to DEQ 11/26/03
FS	☐	
Interim Action/Source Control	☐	
ROD	☐	
RD/RA	☐	
NFA	☐	

DEQ Portland Harbor Site Ranking (Tier 1, 2, or 3): Tier 2

4. SITE OWNER HISTORY

Owner/Occupant	Type of Operation	Years
Brix Maritime (a subsidiary of Foss Maritime Company)	Marine vessel transportation services and maintenance	1993 - present
Knappton Corporation	Tugboat service and fueling	1979 – 1993

5. PROPERTY DESCRIPTION

The Brix site is located in an industrial area along the west bank of the Willamette River, at RM 5.7 (Figure 1; DEQ 1999). Based on aerial photographs observed by Integral, the nearest residences appear to be located approximately 0.2 miles from the site (DEQ 2004a). The Brix site includes two parcels, one adjacent to the river, and a small separate parcel to the south across the access road and adjacent railroad tracks (Figure 1). This second parcel appears to be undeveloped, and no additional information is available regarding it; therefore, this parcel will not be discussed here. The riverfront property is located at approximately 40 feet above mean sea level (Anchor 2003). The topography of the site dips gently to the north to a riprap-armored embankment along the Willamette River, which borders the property to the east (Anchor and HAI 2000). The 4.5-acre parcel is fenced and entirely paved except for the 510-foot-long riverbank (Anchor 2003; Foss Maritime Company 1999). The Brix property is bordered by a vacant property to the south, a service drive, utility right-of-way, and railroad spur to the west, and Shore Oil Company to the north.

Details of the property facilities are provided in Anchor and HAI (2000). The facility includes two primary structures: a two-story office building, and a maintenance office building. A 'general stores' building, an outdoor storage area, small storage sheds, a dock, and a permanently moored covered maintenance barge also exist at the site (Anchor and HAI 2000).

Three underground storage tanks (USTs) are active at the site, located near the maintenance department office building (DEQ 2004b; Anchor and HAI 2000). Two of the tanks are used to store diesel, and the third is used to store lubricating oil (Anchor and HAI 2000). The contents of all three tanks are piped through underground and aboveground piping to a fueling station located on the moored barge (Anchor and HAI 2000). The neighboring Shore Oil Company facility includes numerous aboveground storage tanks (ASTs; Anchor and HAI 2000).

Five private storm water outfalls have been mapped by the City of Portland (Figure 1). The facility reports five stormwater catch basins that discharge through two private outfalls at the river bank (see Supplemental Figure 2; Anchor and HAI 2000). The nature of the three other outfalls shown on Figure 1 are not addressed in the references cited.

City Stormwater outfall 22D (WR 210, Figure 1) formerly existed on the property. The piping for the outfall historically ran under the main office building. Due to the collapse of the pipe, the City requested an easement and installed a new connection and outfall pipe (WR 212, Figure 1) on the northwest boundary of the Foss property in the summer of 1999. The old connection was plugged, and the former outfall was abandoned in place (Anchor and HAI 2000).

Two pad-mounted electrical transformers owned by the utility are located onsite, east of the storage buildings and south of the office building (Anchor and HAI 2000). The transformer east of the storage building was labeled as containing nonregulated levels of PCBs. The transformer south of the office building was not labeled. The potential for PCBs in this transformer is currently being evaluated by Brix (Bayuk, 2004b, pers. comm.). Both transformers were reported to be in good condition (Anchor and HAI 2000).

Foss, through care of the Siegfried Company, has a submerged and submersible land lease with the State of Oregon Division of State Lands: ML-9230 (Anchor and HAI 2000). This lease delineates a 2.05-acre area of the river from the ordinary low water line at each corner of the property tax lot (39), 175 feet into the channel, and along the 510-foot river frontage. The lease took effect May 1,1990 and expired April 30, 2000, at which time it converted to a year-to-year basis (Anchor and HAI 2001). The leased area is shown in Supplemental Figure, Exhibit A.

6. CURRENT SITE USE

Since the site was first developed in 1979, it has been operated as a dispatch and coordination facility for the Brix Maritime Company boat fleet (Anchor and HAI 2000). In addition, minor repairs to small engines and equipment, and onloading and offloading of lubrication oil from tugboats, is performed on site. Brix became a wholly-owned subsidiary of Foss Maritime Company (Foss) in 1993, and owns and operates the facility under a license to use the Foss name (Anchor and HAI 2001).

During site operations, diesel and clean lubricating oil are pumped from USTs located near the maintenance office building to tugs moored at the docks near the maintenance barge (Anchor and HAI 2000). Waste oil and bilge fluids are pumped off the tugs to a large tank on the barge. The wastes are removed by a pump truck and transported to a waste oil recycling facility (Anchor and HAI 2000).

The general stores building is used to store parts, tools, and small quantities of paints and cleaners, and the small storage sheds are used to store compressed gases (Anchor and HAI 2000). An asphalt-paved outdoor drum storage area was reported along the southeastern corner of the property; approximately twenty-one 55-gallon steel drums on wooden pallets were reported during a site visit in 2000 (Anchor and HAI 2000). The drums were observed to be labeled and secured, and no leaks or spills were observed at or in the vicinity of the drums (Anchor and HAI 2000). Subsequent to site visit by the City of Portland, the drum storage area was relocated inside the maintenance building in 2000. The facility is listed as a RCRA conditionally exempt generator (CEG) of hazardous waste, reportedly based on a one-time disposal at an off-site disposal facility of old paint that had accumulated onsite (Anchor and HAI 2001). DEQ records indicate the facility disposed of 480 lbs of "organic paint, ink, lacquer or varnish" in 1994 (DEQ 2004c).

A list of materials stored and used on site, and an estimate of average quantities present, and the storage locations as of September 2001 include (Anchor and HAI 2001):

- Hydraulic fluid (40 gallons), in warehouse
- Antifreeze (12 gallons), in warehouse storage room
- Paint/thinner (80 gallons), in warehouse
- Gasoline (20 gallons, not including UST), in warehouse
- Kerosene (55 gallons) in parts cleaner in shop barge
- Nalcool (40 gallons), in warehouse
- 40-wt Oil (40 gallons), in warehouse
- AC 500 (acid-based cleaner, 16 gallons), in warehouse storage room.

All potentially hazardous wastes generated at the site are recycled at DEQ-approved facilities (Anchor and HAI 2000).

7. SITE USE HISTORY

The site appears to have remained undeveloped until 1979, though some infilling of the northeastern portion of the property was evident in historical aerial photos by 1955 (Anchor and HAI 2000). The property was vegetated prior to development. A small stream appears in a 1961 aerial photo that crossed through the center of the property from east to west. Based on an aerial photo observed by Integral, the two existing buildings, the parking lot, and the permanent barge on the Willamette River are current surface features that were present onsite by 1980 (Anchor and HAI 2000).

UST records on file with the City of Portland Bureau of Environmental Services (BES) and/or Portland Fire Bureau indicate five USTs were installed on the property in 1979; Knappton Tugboat Company was listed as the operator at that time (Anchor and HAI 2000). The tanks were installed in a single tank nest near the maintenance building, and included one 6,000-gallon gasoline UST (UST #2), two 6,000-gallon

lube oil USTs (#1 and #3; containing 30-weight and 40-weight oil, respectively), and two 20,000-gallon diesel USTs (#4 and #5; Anchor 2000). The DEQ Facility Identification Number is #7374 (Anchor 2000). USTs #1 and #2 were decommissioned at the property in 1998, and the systems of three of the existing USTs were upgraded to include tank lining, spill and overfill protection, tank monitoring detectors, and new (rerouted) piping (Anchor 2000; Anchor and HAI 2000).

A release from the 30-weight lube oil transfer lines was reported to DEQ in January 1993 [file number 26-93-009; Anchor and HAI (2000)]. During the investigation of the oil release, diesel contamination of subsurface soil was discovered. Approximately 45 cubic yards of contaminated soil was excavated from the impacted area, and free product was pumped from the excavation. "Oil" was also observed seeping from the walls of the excavation (DEQ 2001, pers. comm.). No groundwater was encountered (Anchor and HAI 2000). The soil was transported offsite for thermal treatment. The oil line was repaired in January 1993. The soil sample results from the 1993 and 2001 subsurface investigations are presented in Section 8.

During tank upgrading activities in 1998, petroleum-impacted soil was discovered, possibly stemming from overfill of either UST #4 or #5 (Anchor and HAI 2000). The potential release was reported to DEQ but no soil samples were collected (Anchor and HAI 2000).

8. CURRENT AND HISTORIC SOURCES AND COPCS

The understanding of the historic and current potential upland and overwater sources at the site is summarized in Table 1. The following sections provide a brief overview of the potential sources and COPCs at the site requiring additional discussion.

8.1. Uplands

The following potential and/or confirmed upland sources have been identified at the Brix facility (Anchor 2000):

- Former gasoline UST and pipelines
- Former lube oil UST and pipelines
- Existing lube oil UST and pipelines
- Existing diesel USTs and pipelines
- Former gasoline dispenser area
- Former 30-weight oil pipeline area
- Stormwater catchbasins
- Transformers.

8.2. Overwater Activities

☒ Yes ☐ No

As mentioned above, overwater activities at the Brix site include maintenance activities performed at a permanently moored, covered barge at the facility dock. The following overwater activities or features at the Brix facility have been identified as potential contaminant sources:

- Vessel servicing operations
- Vessel emissions (hydrocarbon exhaust) and/or discharges
- Maintenance Barge operations
- Dock structure (possible creosote-coated pilings).

8.3. Spills

Known or documented spills at the Foss Maritime Co./Brix Maritime Co. site were obtained either from DEQ's Emergency Response Information System (ERIS) database for the period of

1995 to 2004, from oil and chemical spills recorded from 1982 to 2003 by the U.S. Coast Guard and the National Response Center's centralized federal database [see Appendix E of the Portland Harbor Work Plan (Integral et al. 2004)], from facility-specific technical reports, or from DEQ correspondence. These spills are summarized below.

Date	Material(s) Released	Volume Spilled (gallons)	Spill Surface (gravel, asphalt, sewer)	Action Taken (yes/no)
1/18/1995	Not Specified	Unknown	Willamette River	Unknown; DEQ 145
3/9/1995	Power Steering Fluid	Unknown	Willamette River	Unknown; DEQ 486
4/14/1995	Lube Oil	Unknown	Willamette River	Unknown; DEQ 95
7/15/1995	Diesel Fuel	Unknown	Willamette River	Unknown
3/28/1996	Diesel Fuel	Unknown	Work deck and fueling dock	Unknown
5/7/1996	Not Specified	Unknown	Willamette River	Unknown
6/19/1996	Bilge Oil From Tug	Unknown	Willamette River	No
9/22/1997	Not Specified	Unknown	Willamette River	Unknown
5/31/1998	Diesel Fuel	25	Willamette River	Unknown
2/7/00	Not Specified	Unknown	Willamette River	yes

At least one incident is recorded (October 7, 1997) of a sheen observed emanating from a site outfall (not specified) to the Willamette (Anchor and HAI 2000).

9. PHYSICAL SITE SETTING

An understanding of the site's physical setting began with subsurface explorations in 1993 in response to a lube oil pipeline release and subsequent excavation [see Supplemental Figure 2 from Anchor and HAI (2000, Appendix K)]. Brix Marine conducted additional investigations during the 1998 UST decommission and upgrade, and the more recent investigations of the nature and extent of environmental contaminants at the site (approximately 2001 to 2004). Brix installed 13 soil borings in 1993, 17 Geoprobe borings in 2001, and 7 monitoring wells at the site between July 2002 and July 2003. The following information on the conceptual geology and hydrogeology site model is summarized from subsurface investigations reports and the RI Work Plan (Anchor 2003). Monitoring well locations are shown in Supplemental Figure 5 from Anchor (2003).

9.1. Geology

Results from the subsurface borings indicate that the general site stratigraphy from the ground surface downward consists of the following:

- Fine to medium sand (Recent Fill) - (shallow alluvial aquifer)
- Silt (Pleistocene and Recent Alluvium) - (aquitard).

The stratigraphy at the site is depicted in the cross section [see Supplemental Figure 6 from Anchor (2003)]. The steep hillsides of the Portland West Hills made of basalt are present just west of the site and St. Helens Road. The top of the silt aquitard is likely the former natural ground surface, which is covered by the fine to medium sand placed as dredge fill. The silt aquitard appears contiguous based on the current monitoring well network. The top of the aquitard unit is partially exposed at the base of the riverbank during periods of low river stage. Explorations penetrate only to the depth of the top of the silt aquitard unit.

Based on aerial photos, the historic bankline along the northern portion of the site appears to have been inland of the current site shoreline during the 1930s. In addition, before development, two small drainage channels appeared to cross through the southern and northern portions of the site from east to west [see Supplemental Figures 1936 and 1961 Aerial Photographs from Anchor (2000)]. A 48-inch stormwater pipe across the northern portion of the site generally follows one

of these historic drainage channels.

The current subsurface information is limited to the central and southern two-thirds of the site, where releases are being investigated.

9.2. Hydrogeology

A thin shallow groundwater aquifer is present beneath the site in the sand or recent fill unit. The native silt unit is the aquitard or base of the shallow aquifer. Currently, seven monitoring wells and one river staff gauge are installed to monitor groundwater conditions in the shallow aquifer. The following is a summary of the shallow aquifer information obtained from the RI Work Plan (Anchor 2003).

Shallow Aquifer	
Number of Monitoring Wells	7 (and a river staff gauge)
Groundwater Flow Direction	Northeast toward the river
Horizontal Gradient	0.2 linear foot per foot between the upland and the river's edge 0.014 linear foot per foot on upland portion of site

Recharge to shallow groundwater at the site appears to occur primarily from precipitation, or run off from the hills to the west, which infiltrates upslope of the site (Anchor 2003). The shallow groundwater is interpreted to move along the top of the aquitard from the western edge of the site and discharges to the Willamette River [see Supplemental Figure 6 from Anchor (2003)]. The shallow aquifer is sensitive to seasonal recharge conditions, with one well installed to the base of the sand unit drying up during the dry season.

Seep Locations. No groundwater seeps were identified during the Portland Harbor RI/FS seep reconnaissance survey (GSI 2003). Groundwater has been observed occasionally discharging along the sand-silt interface during low river levels (estimated elevation of 8 feet MSL) during monthly shoreline reconnaissance implemented by Brix (Anchor 2003).

10. NATURE AND EXTENT (*Current Understanding*)

The current understanding of the nature and extent of contamination for the uplands portions of the site is summarized in this section. When no data exist for a specific medium, a notation is made.

10.1. Soil

10.1.1. Upland Soil Investigations ☒ Yes ☐ No

Following the initial excavation of contaminated soil from the lubrication oil transfer lines release in January 1993, a test pit was excavated to a depth of 12 feet below ground surface (bgs) in an attempt to determine the vertical extent of contamination (HAI 1993). Soil samples contained diesel and oil concentrations ranging from <50 up to 53,400 mg/kg. Gasoline was not detected above the 20-mg/kg detection limit (HAI 1993). Although contamination was observed at the bottom of the test pit, the excavation was halted at 12 feet bgs due to the instability of the native soils and the proximity of the maintenance building (HAI 1993). Tank tests were conducted on the diesel tanks onsite following the test pit excavation and the tanks and their associated piping were found to be within tolerance (HAI 1993).

On April 15 and 16, 1993, 13 soil borings were conducted in and around the tank farm and

dispensing system [B-1 through B-13; see Supplemental Figure 5 of Anchor and HAI (2001)]. Soil borings ranged from 5 to 26.5 feet bgs (HAI 1993). Eighteen soil samples were analyzed for parameters including hydrocarbon identification (HCID), gasoline, and/or oil (HAI 1993). Gasoline-range hydrocarbons in subsurface soil ranged from undetected (at a 20-mg/kg detection limit) up to 2,000 mg/kg; oil concentrations ranged from undetected (at a 50 mg/kg detection limit) up to 200 mg/kg (HAI 1993). Diesel was not detected above the 50 mg/kg detection limit (HAI 1993). No remedial action was taken at the time (Anchor and HAI 2000).

Subsequent to DEQ's strategy recommendation in 1999 and requests for additional information about the site, a PA and further subsurface sampling were conducted to assess the extent of subsurface soil and groundwater contamination (Anchor and HAI 2001). Soil sampling performed in May 2001 included 17 push-probe borings [B-14 through B-30; see Supplemental Figure 5 of Anchor and HAI (2001)]. Detected analyte results are summarized below (Anchor and HAI 2001):

Analyte	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)
Gasoline	<0.500	1,370
Diesel	<21.3	2,340
Oil	<53.2	22,200
Total Lead	3.03	4.4
Benzene	<0.050	5.2
Ethylbenzene	<0.00272	23.4
Xylenes	<0.005	134.9
Iso-propylbenzene	<0.005	2.58
1,2,4-Trimethylbenzene	<0.005	59.8
1,3,5-Trimethylbenzene	<0.005	18.7

The subsurface soil analytical results indicated two areas of petroleum hydrocarbon contamination: gasoline and gasoline constituent contamination in a limited area in the vicinity of the former gasoline dispenser, and primarily diesel and oil contamination in the area of the former oil pipeline. Subsurface impacts are generally limited to the sand fill unit that lies above a native silty clay unit at the site. Gasoline and/or oil concentrations were detected in borings within approximately 5 feet of the riverbank [see Supplemental Figure 2; Anchor and HAI (2001)].

Following submittal of the PA/XPA in 2001, DEQ requested Brix to perform an RI to fully define the nature and extent of releases of hazardous substances to the upland portion of the site, to determine whether source control measures are necessary, and to evaluate the potential impacts of the site to the Willamette River (DEQ 2001, pers. comm.). Brix submitted a Pre-RI Work Plan in May 2002 that called for a groundwater investigation at the site. Between July 2002 and June 2003, seven monitoring wells were installed onsite. The results of the groundwater monitoring from these wells is discussed in Section 9.2 below. Soil samples collected during the monitoring well installation were submitted for VOC, TPH, PAHs, and total lead analyses. The analytical results for these soil samples are included in Table 2 of Anchor (2003) (attached). Detected constituents in the monitoring well borings are summarized below:

Analyte	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)
Diesel	<27	360
Oil	<110	390
Total Lead	4	32.5
Ethylbenzene	<0.00071	2.5
Xyelenes	<0.0019	2.733
Naphthalene	<0.0011	64
Isopropylbenzene	<0.00084	7
n-Propylbenzene	<0.00089	18
1,2,4-Trimethylbenzene	<0.0011	59
Naphthalene	<0.0048	22
Acenaphthylene	<0.0048	0.039
Acenaphthene	<0.0048	0.052
Dibenzofuran	<0.0048	0.017
Fluorene	<0.0048	0.11
Phenanthrene	0.009	0.49
Anthracene	0.006	0.088
2-Methylnaphthalene	<0.0048	24
Fluoranthene	0.029	0.72
Pyrene	0.063	0.85
Benzo(a)anthracene	0.009	0.33
Chrysene	0.014	0.56
Benzo(b)fluoranthene	0.012	0.94
Benzo(k)fluoranthene	0.013	0.95
Benzo(a)pyrene	0.014	0.92
Indeno(1,2,3-cd)pyrene	0.021	2
Dibenzo(a,h)anthracene	<0.0048	0.15
Benzo(g,h,i)perylene	0.025	2.3

10.1.2. Riverbank Samples

☐ Yes ☒ No

10.1.3. Summary

An RI Work Plan was submitted to DEQ on November 26, 2003 (Anchor 2003; Bayuk 2004a, pers. comm.). The Work Plan focuses on the potential for the site to be a contaminant source to the river. As such, it does not call for additional soil sampling or remediation. DEQ provided comments on the Work Plan to Brix on February 25, 2004 (A remedial investigation was submitted to DEQ in February 2005 and amended in August 2005 (Bayuk 2005, pers. comm.). A review of the work plan and work conducted since September 2004 will be included in the next iteration of site summary.) In their comments, DEQ noted that the following soil analytical data gaps relative to potential impacts to the river at the site exist:

- The occurrence, extent, and movement of subsurface "oil" observed in the sidewalls of the 1993 excavation are to be considered in the source control screening assessment.

- Soil samples selected for COC analysis from those collected at the margins of the excavation area in May 2001 did not meet the objective of evaluating "worst case" contamination in the source area of the release.

10.2. Groundwater

10.2.1. Groundwater Investigations

☒ Yes ☐ No

Groundwater investigations began at the site in May 2001 with the collection of grab groundwater samples from six Geoprobe borings to investigate potential petroleum hydrocarbon impacts [see Supplemental Figures 4 and 6 from Anchor and HAI (2001)]. Seven shallow monitoring wells were installed at the facility between July 2002 and July 2003 to assess and monitor petroleum impacts to the shallow groundwater beneath the site and evaluate temporal contaminant trends [see Supplemental Figure 5 from Anchor (2003)]. The most recently reviewed groundwater data set is from the October 2003 sampling event presented in the RI Work Plan (Anchor 2003).

10.2.2. NAPL (Historic & Current)

☒ Yes ☐ No

Petroleum hydrocarbon NAPL has been observed in monitoring well MW-3 during the dry season, late summer, and fall; as of September 2004, it has not been observed in monthly measurements since December 2003 (Bayuk 2004b, pers. comm.). MW-3 is installed at the location of the lube oil release and the associated highest TPH-soil concentrations. NAPL thicknesses range from not observed to 0.19 foot thick. NAPL monitoring in the monitoring wells and along the shoreline is ongoing at the site.

10.2.3. Dissolved Contaminant Plumes

☒ Yes ☐ No

A petroleum hydrocarbon plume is present in the shallow aquifer beneath the site. The plume consists of gasoline and heavier-range petroleum hydrocarbon constituents. The only metal analyzed in groundwater is lead. Dissolved lead concentrations in groundwater are generally less than 0.5 part per billion (ppb).

Plume Characterization Status ☐ Complete ☒ Incomplete

Based upon review of the available data, the current monitoring well system appears to have the approximate lateral extent of the plume defined. However, DEQ has not made a conclusion.

Plume Extent

Based upon the data reviewed by GSI, the extent of the petroleum hydrocarbon groundwater plume is shown in Figure 2. The plume is present in the middle and southern portions of the site extending from the former gasoline/fuel dispenser in the west to the river in the east. The sources for the groundwater plume appear to be the locations of the former gasoline/fuel dispenser and the historic lube oil release in 1993 [see Supplemental Figure 2 from Anchor and HAI (2000)].

Min/Max Detections (Current situation)

The October 2003 minimum and maximum petroleum-hydrocarbon-related detections at the site include the following:

Analyte	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)
Total Petroleum Hydrocarbons (TPH)		
TPH-Gasoline	<50	8,100
TPH-Diesel	<250	920
TPH- Dx (Heavy oils)	<500	1,800
Volatile Organic Compounds (VOCs)		
Benzene	<0.5	32
Toluene	<0.5	13
Ethylbenzene	<0.5	270
Total Xylenes	<0.5	470
Naphthalene	<1	460
1,2,4-TMB	<2	1200
1,3,5-TMB	<2	280
n-Propylbenzene	<2	250
n-Butylbenzene	<2	150
Polycyclic Aromatic Hydrocarbons (PAHs)		
LPAH	--	203
HPAH	--	34.97

µg/L = micrograms per liter
TMB = trimethylbenzene
* = detection limit per individual PAH

Current Plume Data

Based upon the data reviewed by GSI, the current estimated extent of the petroleum plume in the shallow aquifer is shown in Figure 2. The plume shown on Figure 2 is based on detections. The wells located at the north (MW-2) and south (MW-7) edges had very low detections of petroleum hydrocarbon constituents.

Preferential Pathways

The historic drainage channel cutting across the southern portion of the site potentially may be a natural preferential groundwater flow pathway [see Supplemental Figures 1936 and 1961 Aerial Photographs from Anchor (2000)]. Monitoring wells MW-4, MW-5, and MW-7 monitor the groundwater conditions near this historic feature.

Several stormwater outfalls and utilities are cutting across the property. However, no information has been presented regarding the depths of the utilities at the facility relative to the shallow groundwater table or if the utility and associated backfill may be a preferential pathway at the site.

Downgradient Plume Monitoring Points (min/max detections)

Monitoring well MW-4 was considered the downgradient monitoring point. The minimum and maximum groundwater results from monitoring well MW-4 (four sampling events July 2002 – October 2003) include the following:

MW-4 Analyte	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)
Total Petroleum Hydrocarbons (TPH)		
TPH-Gasoline	<50	650
TPH-Diesel	<250	<250
TPH- Dx (Heavy oils)	<500	520
Volatile Organic Compounds (VOCs)		
Benzene	<0.5	0.76 (Feb 03 only)
Toluene	<0.5	<0.5
Ethylbenzene	<0.5	2.3 (Feb 03 only)
Total Xylenes	<0.5	2.6
Naphthalene	<1	45 (Feb 03 only)
1,2,4-TMB	<2	3.8 (Feb 03 only)
1,3,5-TMB	<2	2.2 (Feb 03 only)
n-Propylbenzene	<2	35
n-Butylbenzene	<2	3.1 (Feb 03 only)
Polycyclic Aromatic Hydrocarbons (PAHs)		
LPAH	--	19.4
HPAH	--	0.08

µg/L = micrograms per liter
ND = non-detect
TMB = trimethylbenzene
* = detection limit per individual PAH

Visual Seep Sample Data

☐ Yes ☒ No

Seep sample data are not available.

Nearshore Porewater Data

No nearshore porewater data were available in the site's investigation reports.

Groundwater Plume Temporal Trend

Groundwater analytical data have been collected quarterly from the monitoring wells for only 1.5 years. Temporal groundwater plume trends identified from this limited data set include the following:

- NAPL thicknesses increase during the dry season (late summer/early fall) in monitoring well MW-3 and were not observed between December 2003 and September 2004.
- The shallow aquifer saturated thickness is sensitive to the precipitation/infiltration seasons, as demonstrated by some wells going dry during the dry season.

10.2.4. Summary

A dissolved groundwater plume consisting of petroleum hydrocarbon constituents is present beneath the central and southern portions of the site (see Figure 2). Groundwater flows from west to east across the site and ultimately discharges from the shallow aquifer to the river at the interface of the sand-silt aquitard unit. A historic natural drainage feature in the southern half of the site may locally influence shallow groundwater flow directions in this part of the site. No information has been presented regarding the depths of the utilities at the facility relative to the shallow groundwater table and other potential

preferential groundwater pathways at the site.

NAPL was present in monitoring well MW-3 prior to December 2003. The well is located at the site of an historic lube oil pipeline release.

10.3. Surface Water

10.3.1.	**Surface Water Investigation**	☐ Yes	☒ No
10.3.2.	**General or Individual Stormwater Permit (Current or Past)**	☐ Yes	☒ No
	Do other non-stormwater wastes discharge to the system?	☐ Yes	☒ No
10.3.3.	**Stormwater Data**	☐ Yes	☒ No
10.3.4.	**Catch Basin Solids Data**	☐ Yes	☒ No
10.3.5.	**Wastewater Permit**	☐ Yes	☒ No
10.3.6.	**Wastewater Data**	☐ Yes	☒ No

10.3.7. Summary

The City of Portland has mapped five private stormwater outfalls at the site (Figure 1). Site reports reviewed for this summary note that stormwater drains to five catch basins located in parking areas in the southern and western portions of the site. Anchor (2003) reports that these catch basins discharge to the Willamette River through two 4-inch outfalls. The general drainages are shown in Supplemental Figure 5 from Anchor (2003). However, the outfall locations are not shown and numbers are not provided, so it is not known which of the five outfalls shown in Figure 1 correspond to the two outfalls associated with the Brix site.

A 48-inch stormwater outfall is located at the northern corner of the Brix property (WR-212, Figure 1), which receives runoff from Forest Park streams and a small potion of NW St. Helens Road (City of Portland, pers. comm. September 2, 2004). However, while this outfall may not drain the Brix site, City records do not report any City-owned outfall at this location. Possible connections to the nearby private outfalls have not been evaluated.

As noted in Section 5, stormwater outfall 22D (WR 210, Figure 1) formerly existed on the property. The piping for the outfall historically ran under the main office building. Due to the collapse of the pipe, the City requested an easement and installed a new connection and outfall pipe (WR 212, Figure 1) on the northwest boundary of the Foss property in the summer of 1999. The old connection was plugged, and the former outfall was abandoned in place (Anchor and HAI 2000).

As noted in Section 8.3, at least one incident is recorded of a sheen emanating from a site outfall to the Willamette, but the outfall is not specified. No spills to the site catch basins have been recorded (Anchor and HAI 2000).

10.4. Sediment

10.4.1. River Sediment Data ☒ Yes ☐ No

Two surface (0 to 10 cm) sediment samples have been collected from the Willamette River at the Brix facility (Figure 1). These samples were collected in 1997 during the Battelle (2002) survey conducted for the Light Products Survey Group. The samples were analyzed for SVOCs, pesticides, and grain-size distribution; the detected analytical results are summarized in Table 2. Numerous PAHs and other SVOCs were detected (Table 2). Low molecular weight PAHs (LPAHs) were detected at 478 µg/kg (LPSG-S-020-R-1) and

3,462 µg/kg (LPSG-S-18-R1), and high molecular weight PAHs (HPAHs) were detected at 2,644 µg/kg (LPSG-S-18-R1) and 19,408 µg/kg (LPSG-S-020-R-1). One pesticide compound, diphenyl, was detected at 5 µg/kg (LPSG-S-020-R-1) and 21 µg/kg (LPSG-S-18-R1).

10.4.2. Summary

See Final CSM Update.

11. CLEANUP HISTORY AND SOURCE CONTROL MEASURES

11.1. Soil Cleanup/Source Control

As noted above, approximately 45 cubic yards of petroleum-contaminated soil was excavated and removed from the site in 1993 following the detection of contamination in subsurface soil (Anchor and HAI 2000). In 1998, two of the original five USTs were removed, and the spill protection systems of remaining three were updated. Subsurface soil and groundwater sampling identified two areas of petroleum-contaminated soil that have yet to be remediated.

Brix signed a Voluntary Agreement for an RI and Source Control Measures on May 8, 2002 (Anchor 2002c, pers. comm.). DEQ approved the Pre-RI Assessment and groundwater investigation work plans on July 12, 2002 (DEQ 2002b, pers. comm.).

11.2. Groundwater Cleanup/Source Control

Available records indicate that no groundwater cleanup or source control activities have been conducted at the site.

11.3. Other

Site stormwater catch basins in the vicinity of the drum storage area are equipped with sorbent pads that are periodically inspected and replaced as needed (Anchor and HAI 2000).

11.4. Potential for Recontamination from Upland Sources

See Final CSM Update.

12. BIBLIOGRAPHY / INFORMATION SOURCES

References cited:

Anchor. 2003. Remedial Investigation Work Plan. Prepared for Brix Maritime Company, Portland, OR. Anchor Environmental, L.L.C., Seattle, WA.

Anchor and HAI. 2000. Supplemental Preliminary Assessment Summary Report. Anchor Environmental, L.L.C. and Hahn and Associates, Seattle, WA.

Anchor and HAI. 2001. Sampling Results Report in Support of the Preliminary Assessment of the Brix Maritime Company Facility. Anchor Environmental, L.L.C. and Hahn and Associates, Seattle, WA.

Battelle. 2002. Assessment of the Nature of PAH in Surface Sediments along the Southwestern Shore of Portland Harbor Superfund Site. Battelle Memorial Institute, Environmental Forensic Investigation Group, Duxbury, MA.

Bayuk, D. 2004a. Personal communication (telephone communication of 4/28/04 between D. Bayuk, DEQ, and S. FitzGerald, Integral). Oregon Department of Environmental Quality, Portland, OR.

Bayuk, D. 2004b. Personal communication (discussion of 9/2/04 with N. Varnum, Integral). Oregon Department of Environmental Quality, Portland, OR.

Bayuk, D. 2005. Personal communication (discussion of 9/23/05 with N. Varnum, Integral). Oregon Department of Environmental Quality, Portland, OR.

DEQ. 1999. DEQ Site Assessment Program Strategy Recommendation: Foss Maritime Company. Oregon Department of Environmental Quality, Portland, OR.

DEQ. 2001. Personal communication (letter of 11/30/02 from Rodney G. Struck, DEQ, to Kim Johannessen, Johannessen & Associates, regarding Preliminary Assessment, Brix Maritime Company, 9030 N.W. St. Helens Road, Portland, Oregon, ECSI No. 2364). Oregon Department of Environmental Quality, Portland, OR.

DEQ. 2004a. Oregon DEQ Facility Profiler 2.0, Facility Summary Report. http://deq12.deq.state.or.us/FP20/Fpdetail.aspx?SiteID=470. Accessed May 27, 2004. Oregon Department of Environmental Quality, Portland, OR.

DEQ. 2004b. DEQ UST List. Accessed February 19, 2004. http://www.deq.state.or.us/wmc/tank/ustfaclist.htm. Oregon Department of Environmental Quality, Portland, OR.

DEQ. 2004c. Oregon DEQ Hazardous Waste Site Report. EPA IS ORD103014866, Foss Maritime Co. http://www.deq.state.or.us/msd/profilerreports/HazWasteDetail.aspx?siteid=3630. Accessed 5/27/04. Oregon Department of Environmental Quality, Portland, OR.

DEQ. 2004a. Personal communication (letter of 2/25/04 from Dana Bayuk, DEQ, to John Edwards, Anchor, regarding RI Work Plan, Brix Maritime Company, Portland, Oregon, ECSI No. 2364). Oregon Department of Environmental Quality, Portland, OR.

DEQ. 2002b. Personal communication (letter of 7/12/02 from Rodney G. Struck, DEQ, to John Edwards, Anchor, regarding Pre-RI approval, Brix Maritime Site, Portland, Oregon, ECSI No. 2364). Oregon Department of Environmental Quality, Portland, OR.

DEQ. 1999. DEQ Site Assessment Program Strategy Recommendation: Foss Maritime Company. Oregon Department of Environmental Quality, Portland, OR.

Foss Maritime Company, 1999. Personal communication (letter of 3/31/99 to Steve Fortuna, DEQ, from Frank H. Williamson, Assistant General Counsel, Foss). Foss Maritime Company, Portland, OR.

GSI. 2003. Portland Harbor RI/FS: Upland Groundwater Data Review Report, River Mile 2-11, Lower Willamette River. Prepared for the Lower Willamette Group, Portland, OR. Groundwater Solutions, Inc., Portland, OR.

Integral and DEA. 2004. Lower Willamette River February 2004 Multibeam Bathymetric Survey Report. Draft. Prepared for Lower Willamette Group, Portland, OR. Prepared by Integral Consulting, Inc., Mercer Island, WA, and David Evans and Associates, Inc., Portland, OR.

Integral, Windward, Kennedy/Jenks, Anchor Environmental, and Groundwater Solutions. 2004. Portland Harbor RI/FS Programmatic Work Plan. Prepared for the Lower Willamette Group, Portland, OR. Integral Consulting, Inc., Mercer Island, WA.

Other relevant references/information sources

Anchor. 2002a. Personal communication (fax transmission of 6/24/02 to R. Struck, DEQ, from J. Renda, Anchor). Anchor Environmental, L.L.C., Seattle, WA.

Anchor. 2002b. Personal communication (Progress Report #1 of 7/12/02 to R. Struck, DEQ, from J. Edwards, Anchor). Anchor Environmental, L.L.C., Seattle, WA.

DEQ. 2004. DEQ Site Summary Report – Details for Site ID 2364. DEQ Environmental Cleanup Site (ECSI) Database.Accessed February 17, 2004. www.deq.state.or.us/wmc/ecsi/ecsidetail.asp?seqnbr=2364.

Figures:

Figure 1. Site Features.
Figure 2. Upland Groundwater Quality Overview

Tables:

Table 1. Potential Sources and Transport Pathways Assessment
Table 2. Queried Sediment Chemistry Data

Supplemental Figures:

Figure 2. Site Map (Anchor and HAI 200)
Exhibit A. Mar Com Waterway Lease Map
Figure 2. UST Area Map (Anchor 2003)
Figure 2. Facility Map (Anchor and HAI 2000)
Figure 4. Sample Locations Map (Anchor and HAI 2001)
Figure 5. Well Locations and Potentiometric Surface Map (Anchor 2003)
Figure 5. Petroleum Hydrocarbons in Soil (Anchor and HAI 2001)
Figure 6. Geologic Profile A-A (Anchor 2003)
Figure 6. Petroleum Constituents in GW (Anchor and HAI 2001)

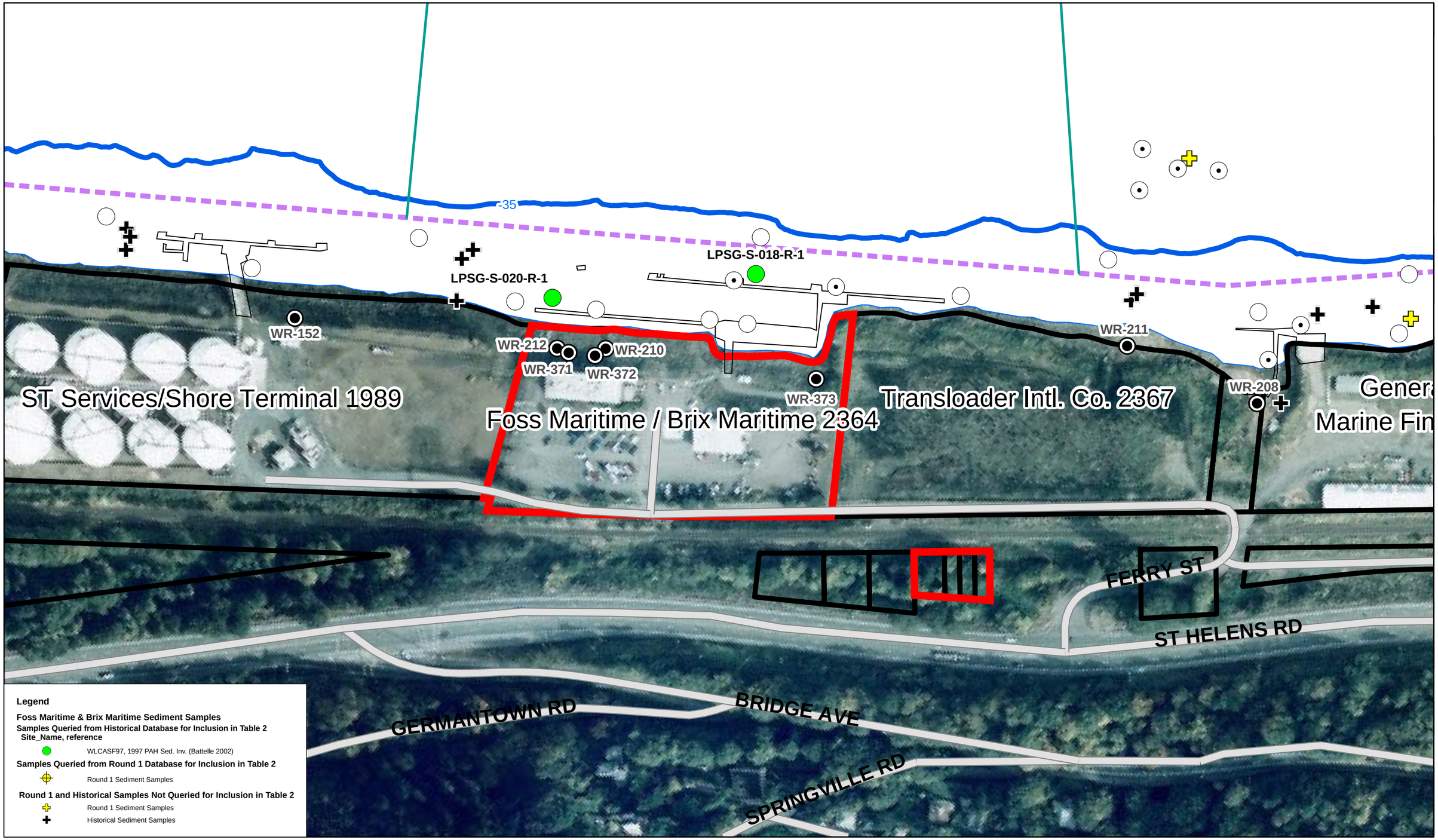
1936 Aerial Photograph, Shoreline
1961 Aerial Photograph, Preferential Pathway

Supplemental Tables:

Table 2. Soil Data (Anchor 2003)

097204\00001\652580 V002

FIGURES



Legend

Foss Maritime & Brix Maritime Sediment Samples

Samples Queried from Historical Database for Inclusion in Table 2
Site_Name, reference

- WLCASF97, 1997 PAH Sed. Inv. (Battelle 2002)

Samples Queried from Round 1 Database for Inclusion in Table 2

- Round 1 Sediment Samples

Round 1 and Historical Samples Not Queried for Inclusion in Table 2

- Round 1 Sediment Samples
- Historical Sediment Samples

integral consulting inc.

LWG Lower Willamette Group

Map Document: (G:\Projects\Portland_Harbor\LWG-Map-Projects\Conseptual_Site_Model\Sample_Locations_3rd_Group.mxd)
10/03/2005 -- 01:13:45 PM

Areal Photo Date: October 2001.
Base Map features from Portland Metro's RLIS.

Outfall information contained on this map is accurate according to available records; however, the City of Portland makes no warranty, expressed or implied, as to the completeness or accuracy of the information published (updated June 2005).

Legend

- Outfalls
- Seep Photo Location (Not location of actual Seep)
- Selected ECSI Site Property Boundary
- Navigation Channel
- Docks & In-water Structures
- River Miles
- -35ft. Contour (NAVD 88)

Human Use Areas

- Dockside Worker
- Recreational Beach Use
- Transient

LWG Round 2 Proposed Sediment Samples

- Surface Sample Only
- Core & Surface Sample

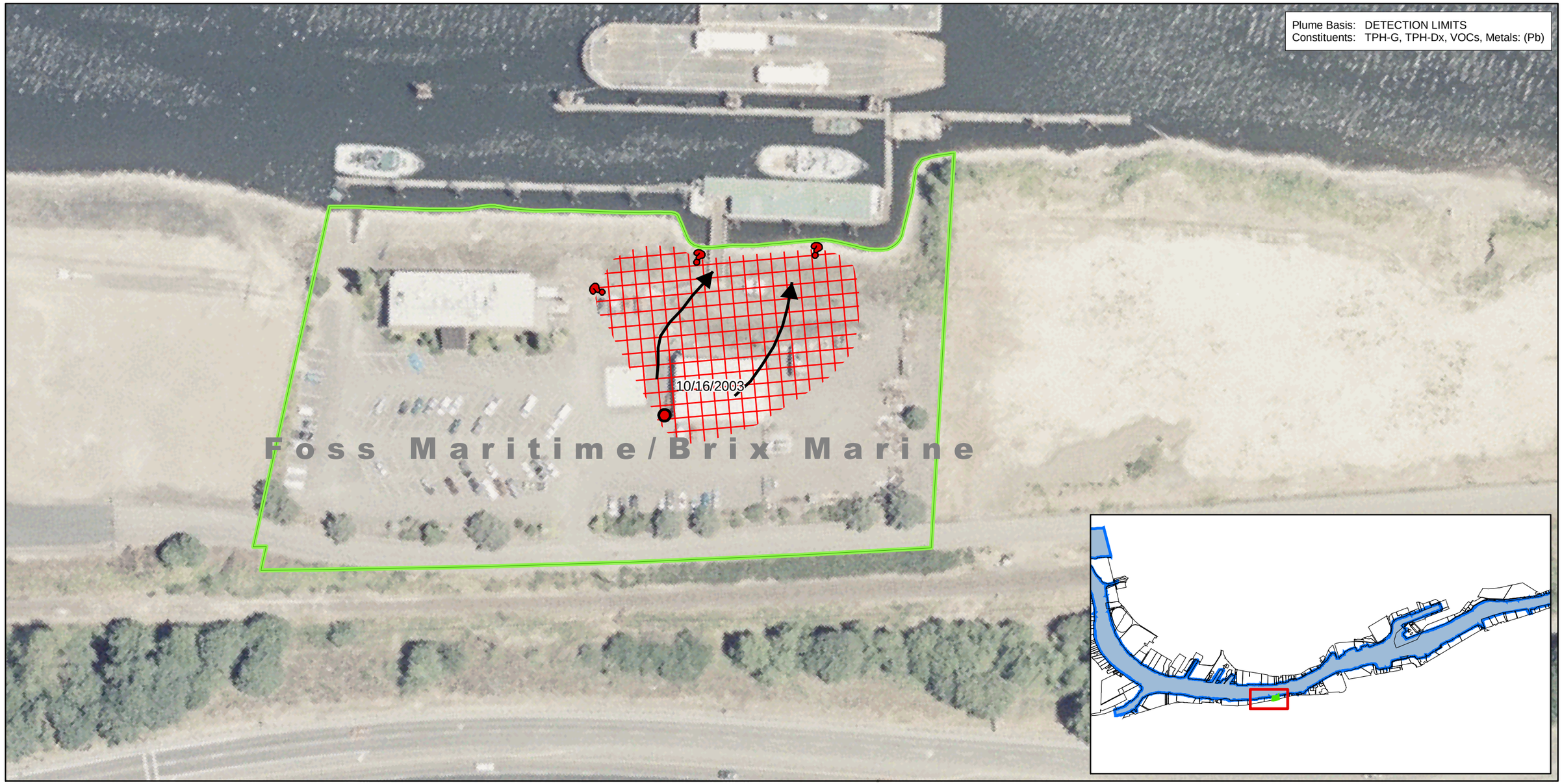
0 50 100 200 Feet

DRAFT

DO NOT QUOTE OR CITE. This document is currently under review by US EPA and its federal, state, and tribal partners, and is subject to change in whole or in part.

Figure 1-Site Features
Portland Harbor RI/FS
Conceptual Site Model
Foss Maritime/Brix Maritime
ECSI 2364

DRAFT



Groundwater Solutions Inc.

LWG Lower Willamette Group

0 75 150 Feet

FEATURE SOURCES:
Transportation, Water, Property, Zoning or Boundaries: Metro RLIS.
ECSI site locations were summarized in December, 2002
and January, 2003 from ODEQ ECSI files.

Map Creation Date: August 11, 2004

File Name: Fig2_FossMaritime_SummaryMap.mxd

LEGEND

- Site Boundary
- Maximum Detection Location
- General Groundwater Flow

Contaminant Type

- Petroleum related

Extent of Impacted Groundwater

For details, refer to plume interpretation table in CSM document.

- Single or isolated detection of COI's. Extent or continuity of impacted groundwater between sample points is uncertain. Color based on contaminant type.
- Estimated extent of impacted groundwater area. Color based on contaminant type.

Figure 2
Portland Harbor RI/FS
Foss Maritime/Brix Marine
Upland Groundwater Quality Overview

PRIVILEGED AND CONFIDENTIAL:
Work product prepared in anticipation of litigation.

DO NOT QUOTE OR CITE:
This document is currently under review by US EPA and its federal, state and tribal partners, and is subject to change in whole or part.

TABLES

Foss Maritime Company/Brix Maritime Company

Table 1. Potential Sources and Transport Pathways Assessment

	Media Impacted					COIs																Potential Complete Pathway				
						TPH			VOCs																		
Description of Potential Source	**Surface Soil**	**Subsurface Soil**	**Groundwater**	**Catch Basin Solids**	**River Sediment**	**Gasoline-Range**	**Diesel - Range**	**Heavier - Range**	**Petroleum-Related (e.g. BTEX)**	**VOCs**	**Chlorinated VOCs**	**SVOCs**	**PAHs**	**Phthalates**	**Phenolics**	**Metals**	**PCBs**	**Herbicides and Pesticides**	**Dioxins/Furans**	**Butyltins**	**Overland Transport**	**Groundwater**	**Direct Discharge - Overwater**	**Direct Discharge - Storm/Wastewater**	**Riverbank Erosion**
Upland Areas																										
A																										
Former gasoline UST and pipelines		✓	✓		?	✓			✓							✓						✓			
Former lube oil UST and pipelines		✓	✓		?			✓					✓									✓			
Existing lube oil UST and pipelines		✓			?			✓					✓									?			
Existing diesel USTs and pipelines		✓			?		✓															?			
Former gasoline dispenser area		✓	✓		?	✓	✓	✓								✓					?	✓			
Former 30-weight oil pipeline area		✓	✓		?	✓	✓	✓					✓								?	✓		?	
Catchbasins				?	?	✓	✓	✓				✓	✓			✓	?				?			?	
Transformers	?	?		?	?			✓									✓				?			?	
Overwater Areas																										
B																										
Vessel servicing operations					✓		✓	✓	✓							✓				✓			✓			
Vessel emissions and/or discharges							✓	✓	✓							✓							✓			
Maintenance Barge operations							✓	✓	✓	✓	✓	✓	✓			✓							✓			
Dock structure													✓			✓										
Other Areas/Other Issues																										

Notes:

[1] All information provided in this table is referenced in the site summaries. If information is not available or inconclusive, a ? may be used, as appropriate. No new information is provided in this table.

✓ = Source, COI are present or current or historic pathway is determined to be complete or potentially complete.

? = There is not enough information to determine if source or COI is present or if pathway is complete.

Blank = Source, COI and historic and current pathways have been investigated and shown to be not present or incomplete.

UST	Underground storage tank
AST	Above-ground storage tank
TPH	Total petroleum hydrocarbons
VOCs	Volatile organic compounds
SVOCs	Semivolatile organic compounds
PAHs	Polycyclic aromatic hydrocarbons
BTEX	Benzene, toluene, ethylbenzene, and xylenes
PCBs	Polychorinated biphenols

Table 2. Queried Sediment Chemistry Data

		Site Name	WLCASF97	WLCASF97
		Location ID	WLCASF97S018	WLCASF97S020
		Location Name	LPSG-S-018-R-1	LPSG-S-020-R-1
		Sample Date	06/12/1997	06/10/1997
		Sample ID	WLCASF97S018W4160	WLCASF97S020W4147
		Start Depth	0	0
		End Depth	10	10
Chemical Name	Unit	Surface or Subsurface		
Total organic carbon	%	surface	2.5	1.6
Gravel	%	surface	13.9	7.5
Sand	%	surface		
Very coarse sand	%	surface	3.3	6.3
Coarse sand	%	surface	18.1	27.7
Medium sand	%	surface	41.4	45.7
Fine sand	%	surface	12.5	6.9
Very fine sand	%	surface	3.3	2.3
Fines	%	surface		
Silt	%	surface		
Coarse silt	%	surface	1.4	.7
Medium silt	%	surface	1.9	.8
Fine silt	%	surface	1.4	.6
Very fine silt	%	surface	1.2	.6
Clay	%	surface		
8-9 Phi clay	%	surface	.6	.3
9-10 Phi clay	%	surface	.4	.3
>10 Phi clay	%	surface	.6	.3
Aluminum	mg/kg	surface		
Antimony	mg/kg	surface		
Arsenic	mg/kg	surface		
Cadmium	mg/kg	surface		
Chromium	mg/kg	surface		
Copper	mg/kg	surface		
Lead	mg/kg	surface		
Manganese	mg/kg	surface		
Mercury	mg/kg	surface		
Nickel	mg/kg	surface		
Selenium	mg/kg	surface		
Silver	mg/kg	surface		
Thallium	mg/kg	surface		
Zinc	mg/kg	surface		
Barium	mg/kg	surface		
Beryllium	mg/kg	surface		
Calcium	mg/kg	surface		
Cobalt	mg/kg	surface		
Iron	mg/kg	surface		
Magnesium	mg/kg	surface		
Potassium	mg/kg	surface		
Sodium	mg/kg	surface		
Vanadium	mg/kg	surface		
2-Methylnaphthalene	ug/kg	surface		
Acenaphthene	ug/kg	surface	135	59
Acenaphthylene	ug/kg	surface	260	22
Anthracene	ug/kg	surface	689	70
Fluorene	ug/kg	surface	127	38
Naphthalene	ug/kg	surface	97	29
Phenanthrene	ug/kg	surface	2154	260
Low Molecular Weight PAH	ug/kg	surface	3462 A	478 A

Table 2. Queried Sediment Chemistry Data

		Site Name	WLCASF97	WLCASF97
		Location ID	WLCASF97S018	WLCASF97S020
		Location Name	LPSG-S-018-R-1	LPSG-S-020-R-1
		Sample Date	06/12/1997	06/10/1997
		Sample ID	WLCASF97S018W4160	WLCASF97S020W4147
		Start Depth	0	0
		End Depth	10	10
Chemical Name	Unit	Surface or Subsurface		
Dibenz(a,h)anthracene	ug/kg	surface	144	39
Benz(a)anthracene	ug/kg	surface	1267	204
Benzo(a)pyrene	ug/kg	surface	1976	306
Benzo(b)fluoranthene	ug/kg	surface	967	217
Benzo(g,h,i)perylene	ug/kg	surface	2076	253
Benzo(k)fluoranthene	ug/kg	surface		
Chrysene	ug/kg	surface	1486	237
Fluoranthene	ug/kg	surface	3782	437
Indeno(1,2,3-cd)pyrene	ug/kg	surface	1461	248
Pyrene	ug/kg	surface	5104	478
Benzo(b+k)fluoranthene	ug/kg	surface		
Benzo(j+k)fluoranthene	ug/kg	surface	1145	225
High Molecular Weight PAH	ug/kg	surface	19408 A	2644 A
Polycyclic Aromatic Hydrocarbons	ug/kg	surface	22870 A	3122 A
Benzo(e)pyrene	ug/kg	surface	1147	203
C1-Dibenzothiophene	ug/kg	surface	266	13
C1-Chrysene	ug/kg	surface	416	103
C1-Fluorene	ug/kg	surface	144	11
C1-Naphthalene	ug/kg	surface	36	12
C1-Fluoranthene/pyrene	ug/kg	surface	1387	172
C1-Phenanthrene/anthracene	ug/kg	surface	847	78
C2-Dibenzothiophene	ug/kg	surface	202	17
C2-Chrysene	ug/kg	surface	118	58
C2-Fluorene	ug/kg	surface	102	12
C2-Naphthalene	ug/kg	surface	94	16
C2-Fluoranthene/pyrene	ug/kg	surface	274	70
C2-Phenanthrene/anthracene	ug/kg	surface	426	68
C3-Dibenzothiophene	ug/kg	surface	114	17
C3-Chrysene	ug/kg	surface	50	39
C3-Fluorene	ug/kg	surface	100	17
C3-Naphthalene	ug/kg	surface	144	19
C3-Fluoranthene/pyrene	ug/kg	surface	99	47
C3-Phenanthrene/anthracene	ug/kg	surface	227	48
C4-Dibenzothiophene	ug/kg	surface	39	15
C4-Chrysene	ug/kg	surface	26	16
C4-Naphthalene	ug/kg	surface	96	14
C4-Phenanthrene/anthracene	ug/kg	surface	68	19
Total benzofluoranthenes (b+k (+j))	ug/kg	surface	2112	442
Diphenyl	ug/kg	surface	21	5
2,4,5-Trichlorophenol	ug/kg	surface		
2,4,6-Trichlorophenol	ug/kg	surface		
2,4-Dichlorophenol	ug/kg	surface		
2,4-Dimethylphenol	ug/kg	surface		
2-Chlorophenol	ug/kg	surface		
2-Methylphenol	ug/kg	surface		
2-Nitrophenol	ug/kg	surface		
4,6-Dinitro-2-methylphenol	ug/kg	surface		
4-Chloro-3-methylphenol	ug/kg	surface		
4-Methylphenol	ug/kg	surface		

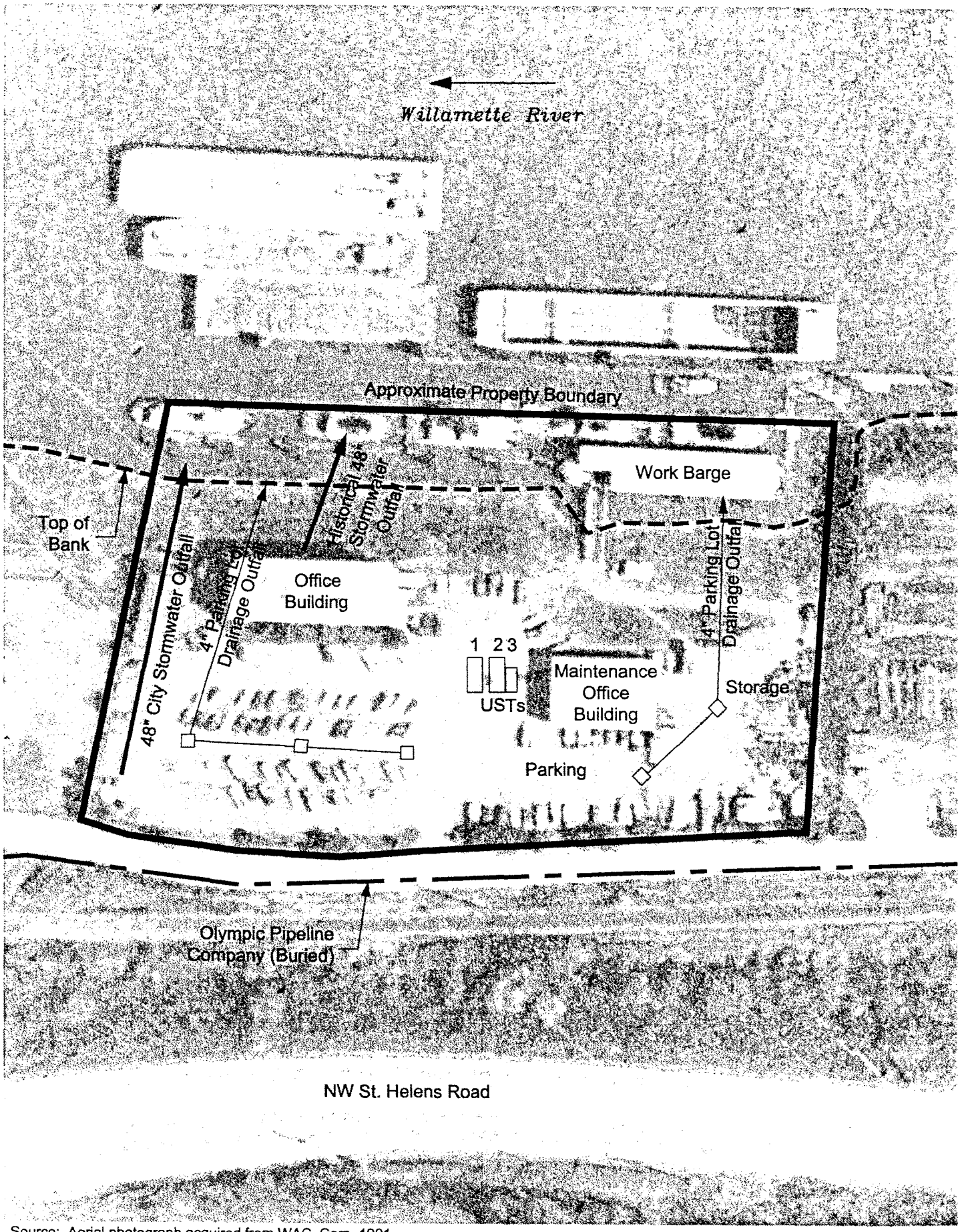
Table 2. Queried Sediment Chemistry Data

		Site Name	WLCASF97	WLCASF97
		Location ID	WLCASF97S018	WLCASF97S020
		Location Name	LPSG-S-018-R-1	LPSG-S-020-R-1
		Sample Date	06/12/1997	06/10/1997
		Sample ID	WLCASF97S018W4160	WLCASF97S020W4147
		Start Depth	0	0
		End Depth	10	10
Chemical Name	Unit	Surface or Subsurface		
4-Nitrophenol	ug/kg	surface		
Pentachlorophenol	ug/kg	surface		
Phenol	ug/kg	surface		
Dimethyl phthalate	ug/kg	surface		
Diethyl phthalate	ug/kg	surface		
Dibutyl phthalate	ug/kg	surface		
Butylbenzyl phthalate	ug/kg	surface		
Di-n-octyl phthalate	ug/kg	surface		
Bis(2-ethylhexyl) phthalate	ug/kg	surface		
Bis(2-chloro-1-methylethyl) ether	ug/kg	surface		
2,4-Dinitrotoluene	ug/kg	surface		
2,6-Dinitrotoluene	ug/kg	surface		
2-Chloronaphthalene	ug/kg	surface		
2-Nitroaniline	ug/kg	surface		
3,3'-Dichlorobenzidine	ug/kg	surface		
3-Nitroaniline	ug/kg	surface		
4-Bromophenyl phenyl ether	ug/kg	surface		
4-Chloroaniline	ug/kg	surface		
4-Chlorophenyl phenyl ether	ug/kg	surface		
4-Nitroaniline	ug/kg	surface		
Benzoic acid	ug/kg	surface		
Benzyl alcohol	ug/kg	surface		
Bis(2-chloroethoxy) methane	ug/kg	surface		
Bis(2-chloroethyl) ether	ug/kg	surface		
Carbazole	ug/kg	surface		
Dibenzofuran	ug/kg	surface	25	18
Hexachlorobenzene	ug/kg	surface		
Hexachlorobutadiene	ug/kg	surface		
Hexachlorocyclopentadiene	ug/kg	surface		
Hexachloroethane	ug/kg	surface		
Isophorone	ug/kg	surface		
Nitrobenzene	ug/kg	surface		
N-Nitrosodipropylamine	ug/kg	surface		
N-Nitrosodiphenylamine	ug/kg	surface		
Dibenzothiophene	ug/kg	surface	247	25
Perylene	ug/kg	surface	565	116
1,2-Dichlorobenzene	ug/kg	surface		
1,3-Dichlorobenzene	ug/kg	surface		
1,4-Dichlorobenzene	ug/kg	surface		
1,2,4-Trichlorobenzene	ug/kg	surface		

SUPPLEMENTAL FIGURES

Figure 2. Site Map (Anchor and HAI 200)
Exhibit A. Mar Com Waterway Lease Map
Figure 2. UST Area Map (Anchor 2003)
Figure 2. Facility Map (Anchor and HAI 2000)
Figure 4. Sample Locations Map (Anchor and HAI 2001)
Figure 5. Well Locations and Potentiometric Surface Map (Anchor 2003)
Figure 5. Petroleum Hydrocarbons in Soil (Anchor and HAI 2001)
Figure 6. Geologic Profile A-A (Anchor 2003)
Figure 6. Petroleum Constituents in GW (Anchor and HAI 2001)

1936 Aerial Photograph, Shoreline
1961 Aerial Photograph, Preferential Pathway



Source: Aerial photograph acquired from WAC, Corp. 1991.

ANCHOR ENVIRONMENTAL, L.L.C.

0 100
Scale in Feet

10/04/00 BRX002c-01.dwg 99-056-01

Figure 2
Site Map

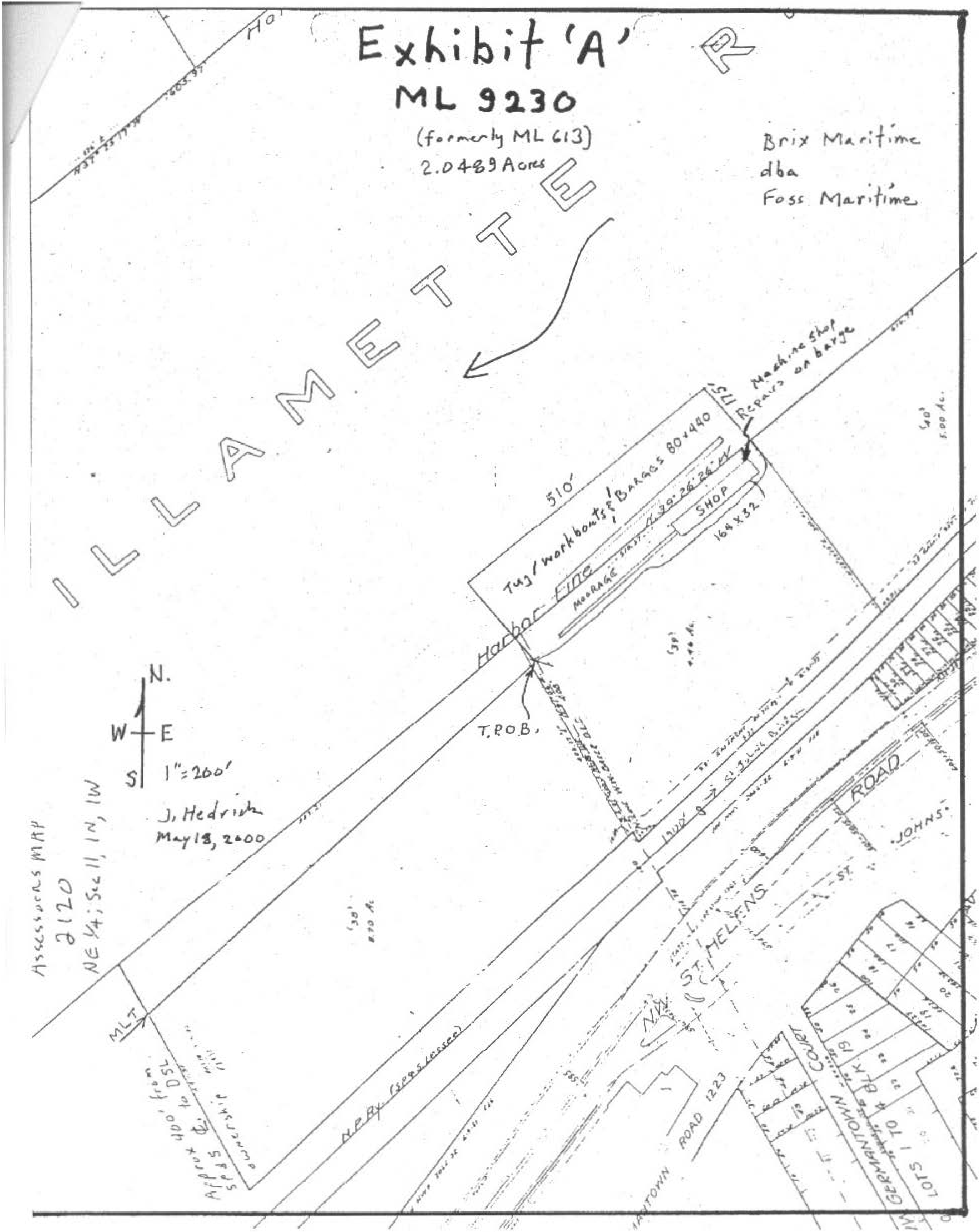
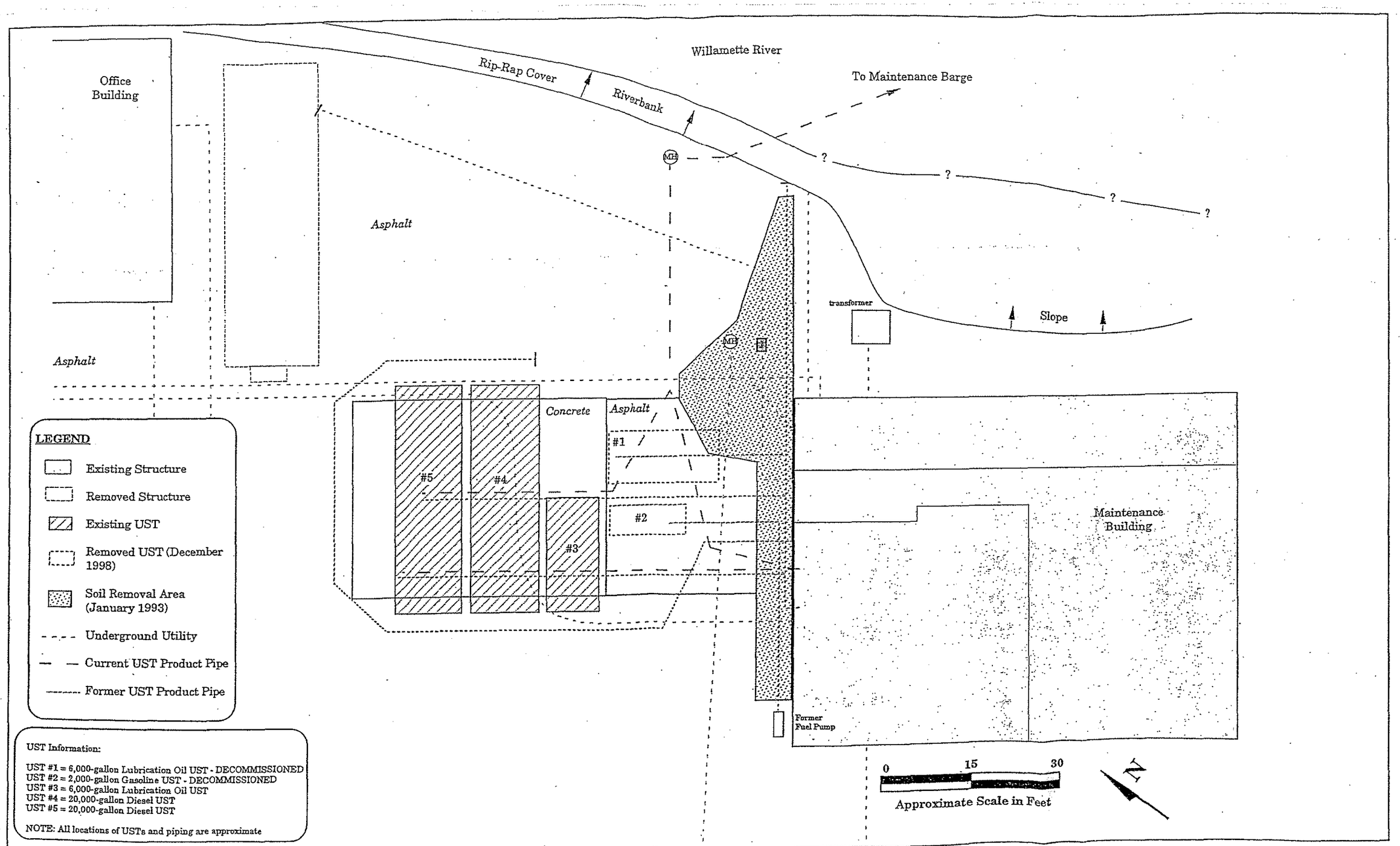


Exhibit 'A'
ML 9230
(formerly ML 613)
2.0489 Acres
Brix Maritime
dba
Foss Maritime
WILLAMETTE R
Machine shop
Repairs on barge
510'
175'
Tug/workboats & Barges 80x440
SHOP
164x32
MOORAGE
Harbor Line
T.P.O.B.
N.
W
E
S
1"=200'
J. Hedrick
May 18, 2000
Assessors MAP
2120
NE 1/4; Sec 11, 1N, 1W
MLT
Approx 400' from SP&S to DSL
SP&S ownership
N.P.Ry (SP&S Lessee)
ROAD
ST. JOHNS
ST. HELENS
ROAD 1223
NW
COURT
GERMANTOWN BLK 19
LOTS 1 TO



ANCHOR ENVIRONMENTAL, L.L.C.

Figure 2
Underground Storage Tank Area Map

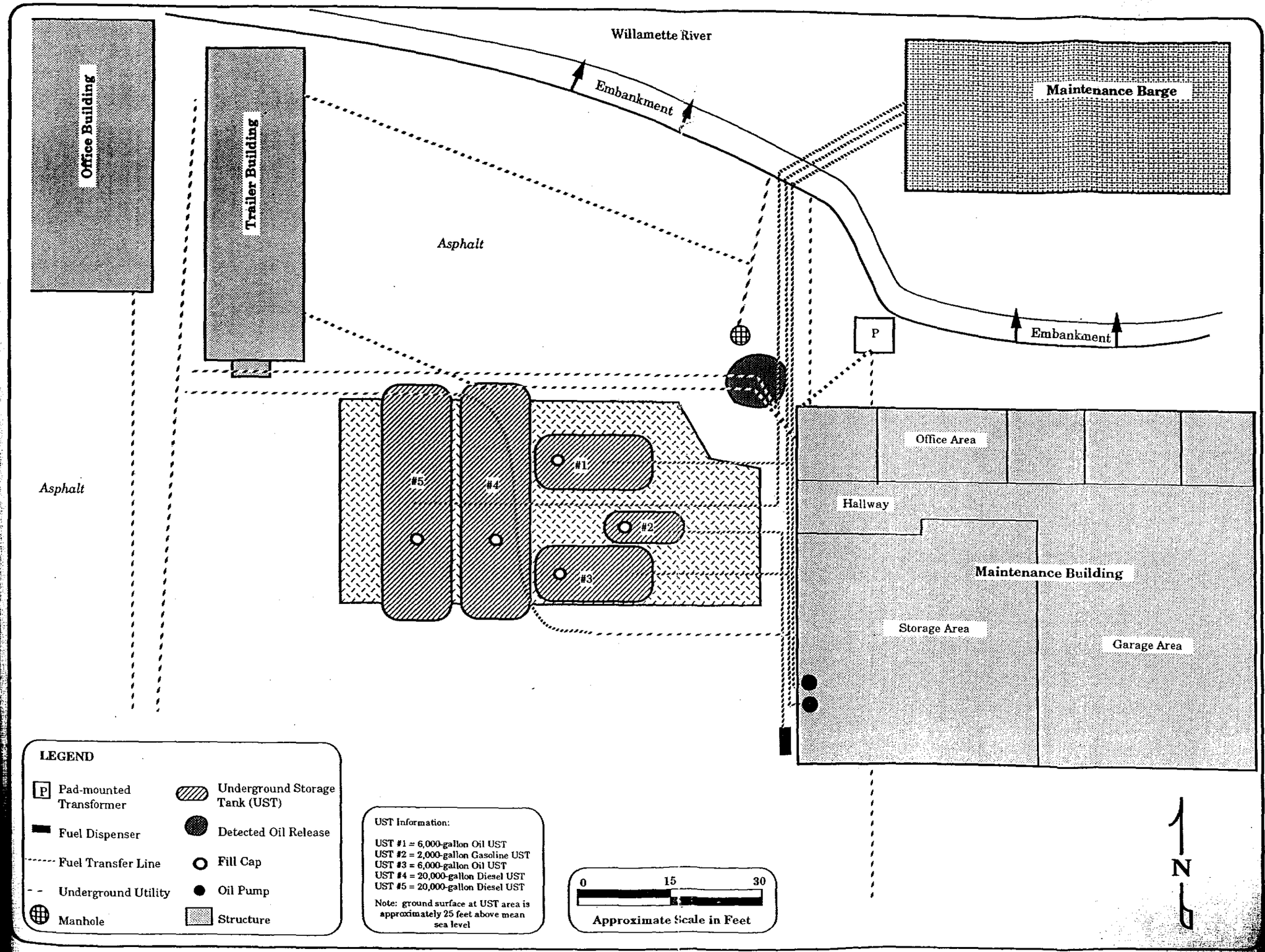


Figure 2

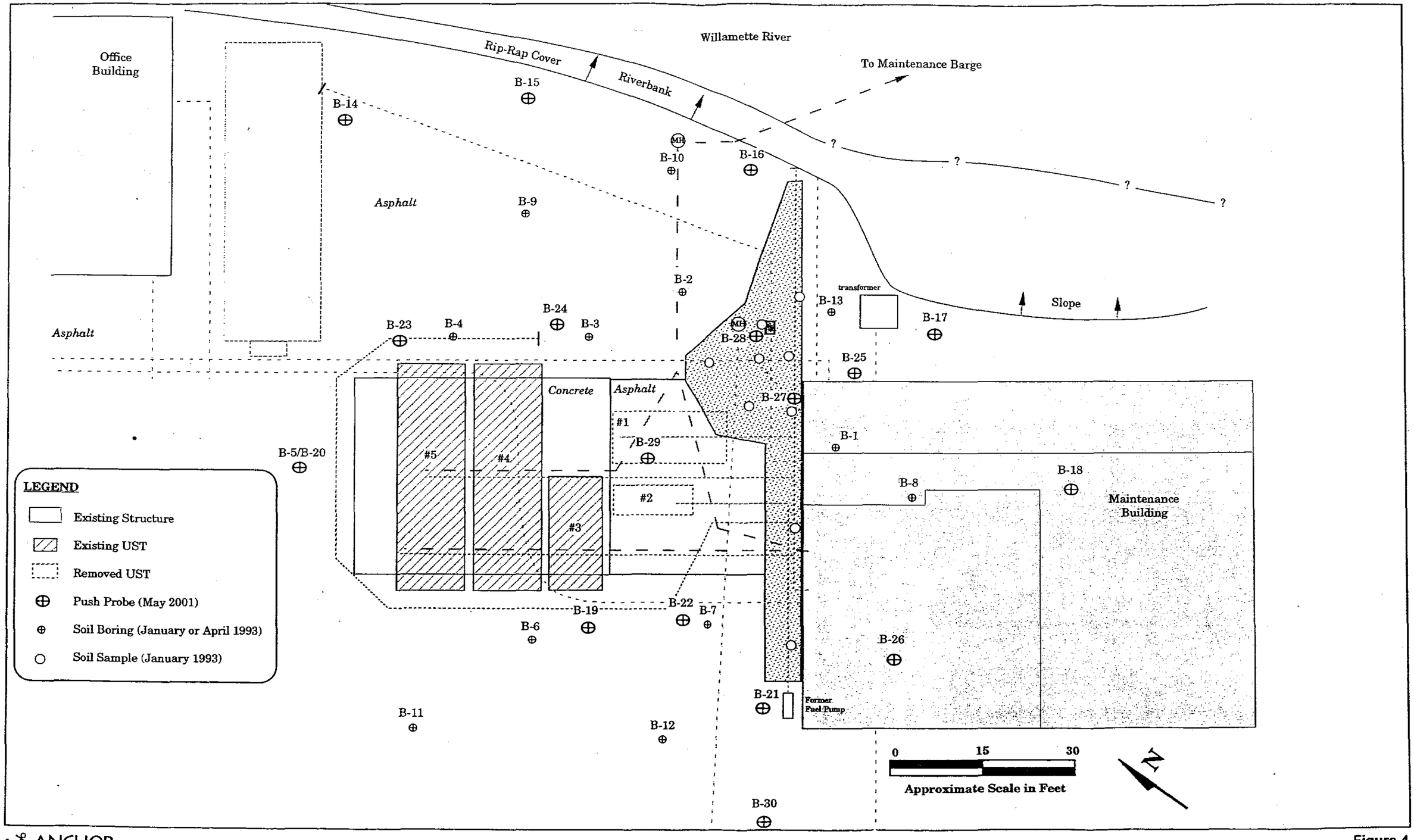
Facility Map

Subsurface Investigation
Brix Maritime Company
9030 NW St. Helens Road
Portland, Oregon

HAHN & ASSOCIATES
INCORPORATED
ENVIRONMENTAL MANAGEMENT
434 NW SIXTH AVENUE, SUITE 203
PORTLAND, OREGON 97209
503/796-0717

May 1993

Project 2289



ANCHOR ENVIRONMENTAL, L.L.C.

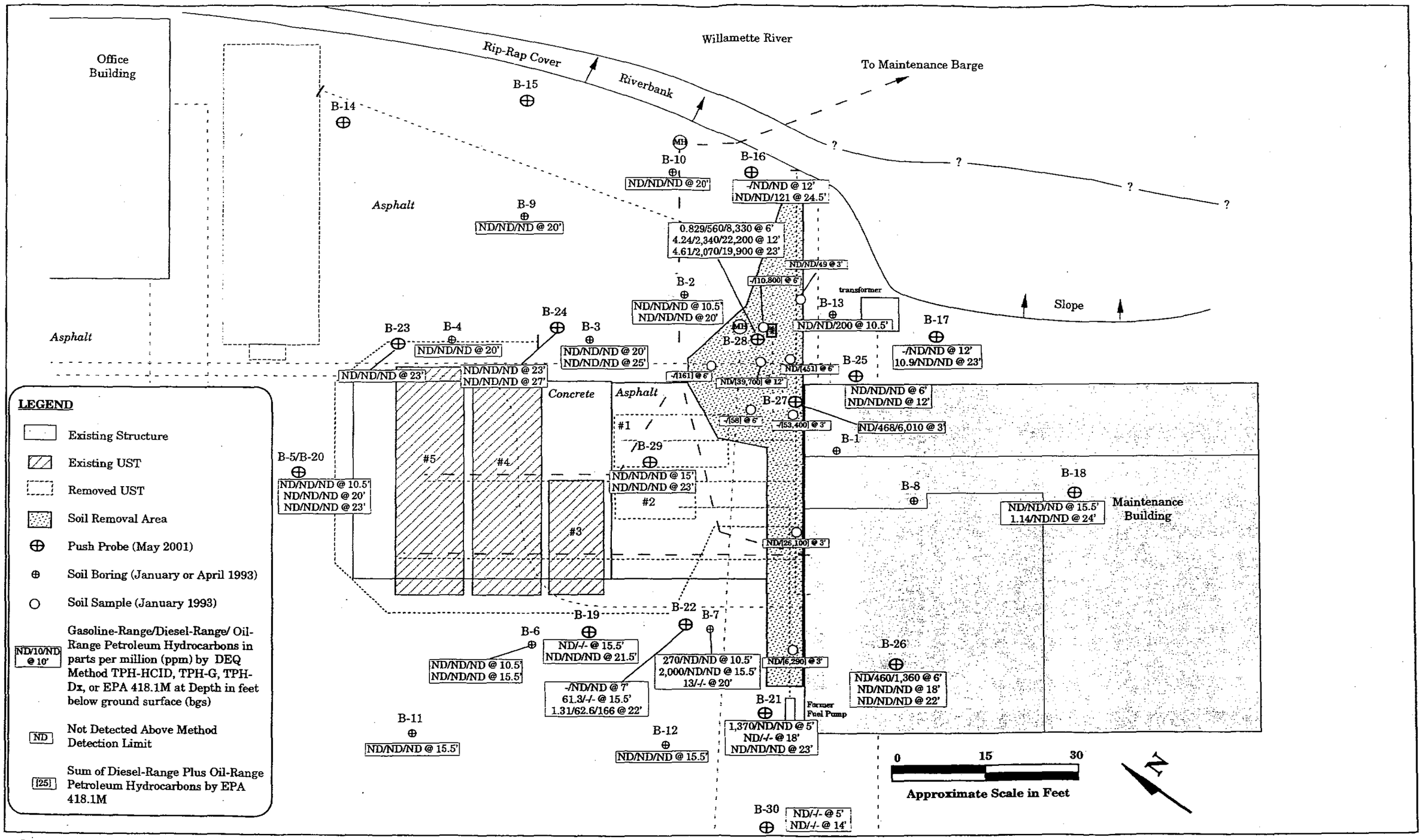
Figure 4
Sample Location Map

Source: Aerial photograph acquired from WAC, Corp. 1991.

Nov 05, 2003 3:57pm cdavidson K:\Jobs\990056-Brix_Maritime\Drawings\990056011990056011-04.dwg Fig 2

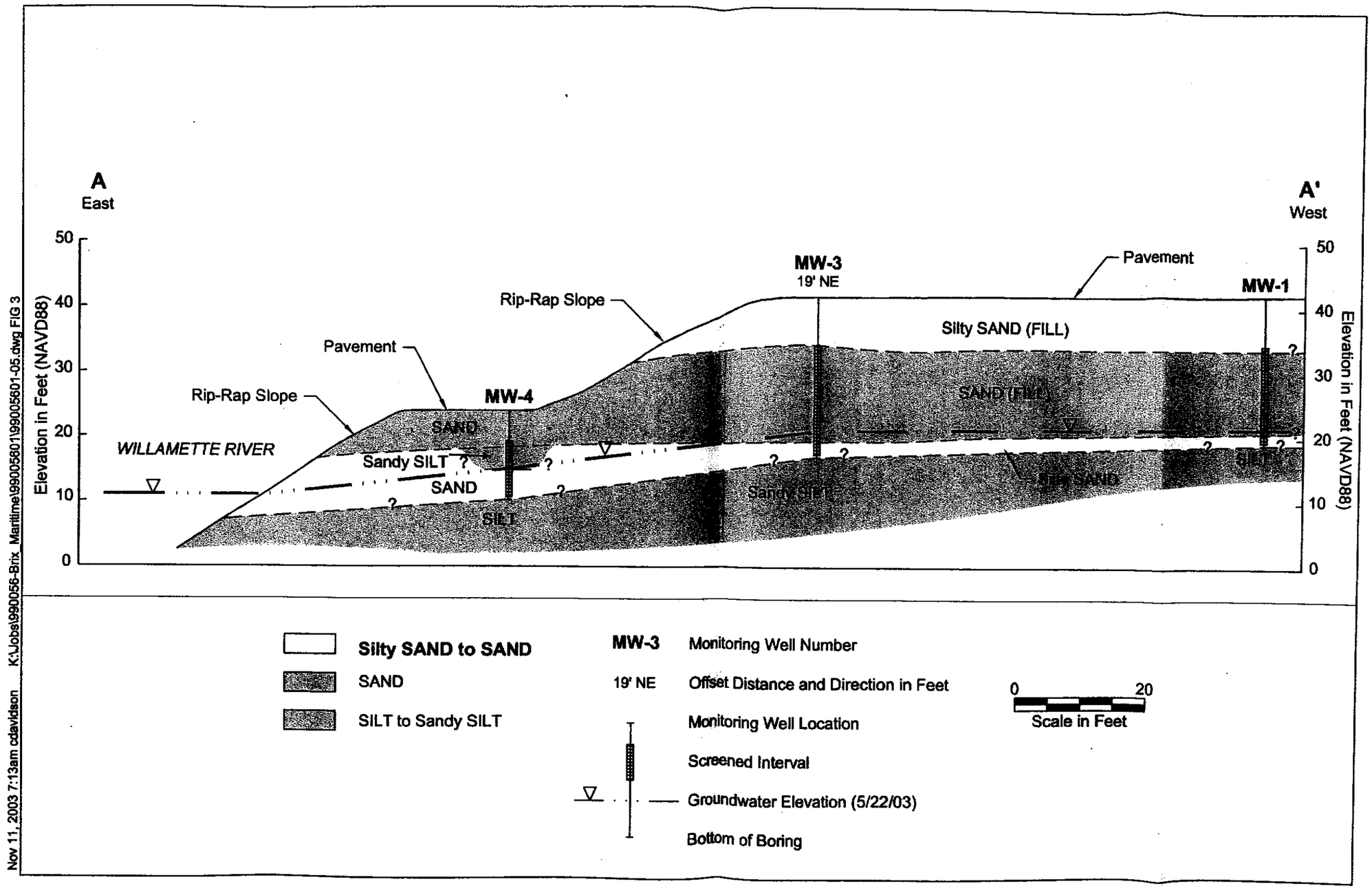
ANCHOR ENVIRONMENTAL, L.L.C.

Figure 5
Well Location and Potentiometric Surface Map (July 7, 2003)
Brix Maritime



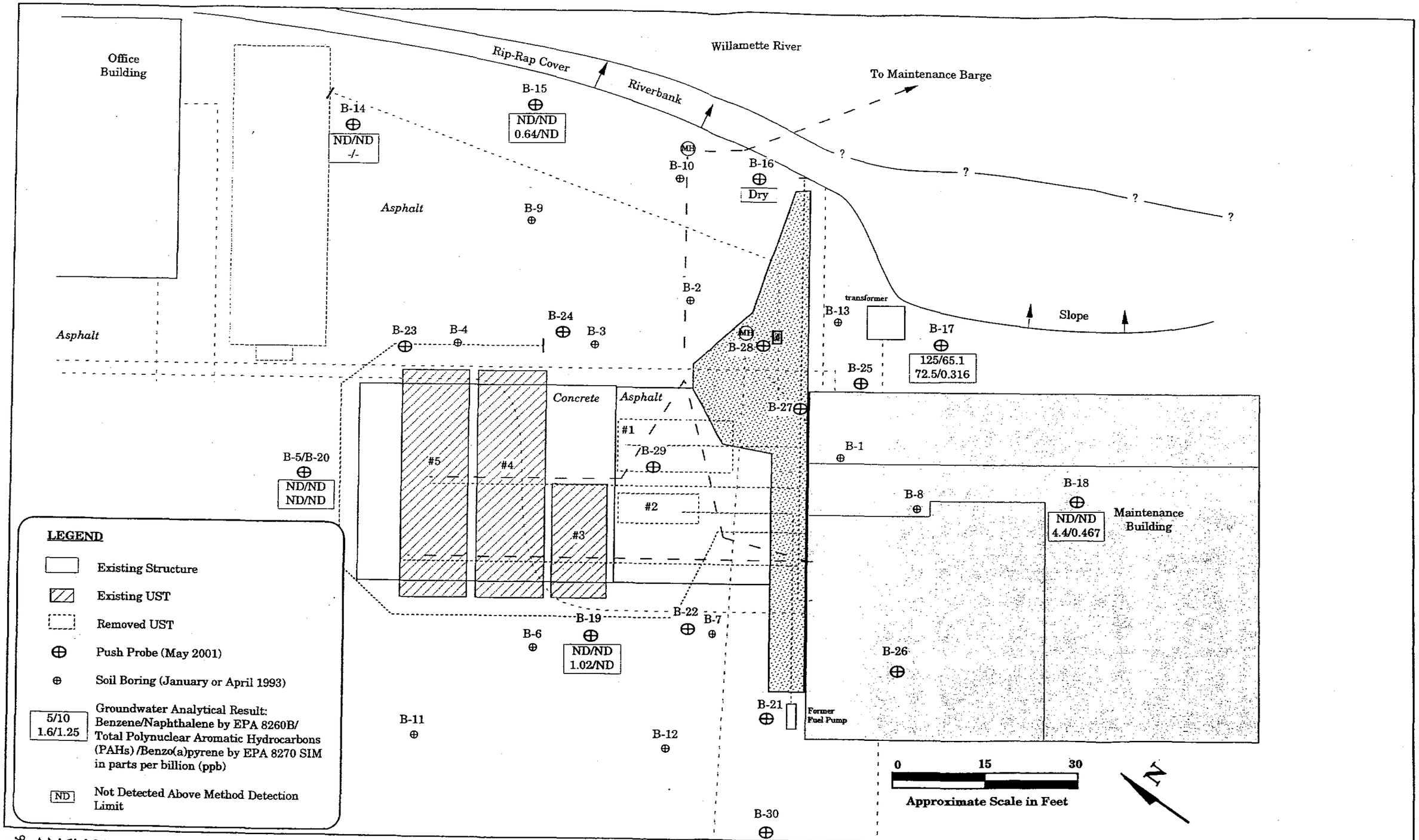
ANCHOR ENVIRONMENTAL, L.L.C.

Figure 5
Petroleum Hydrocarbons in Soil



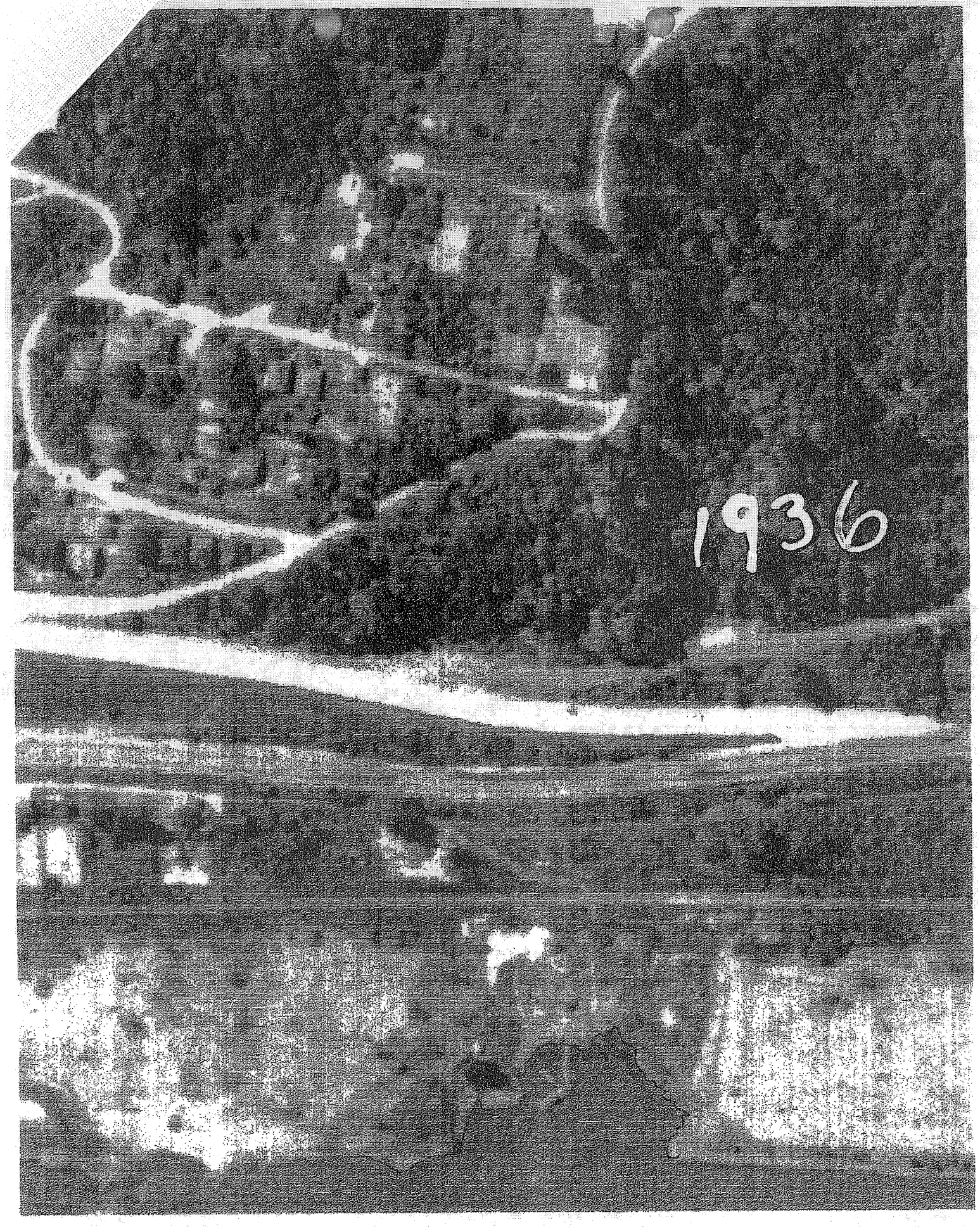
ANCHOR ENVIRONMENTAL, L.L.C.

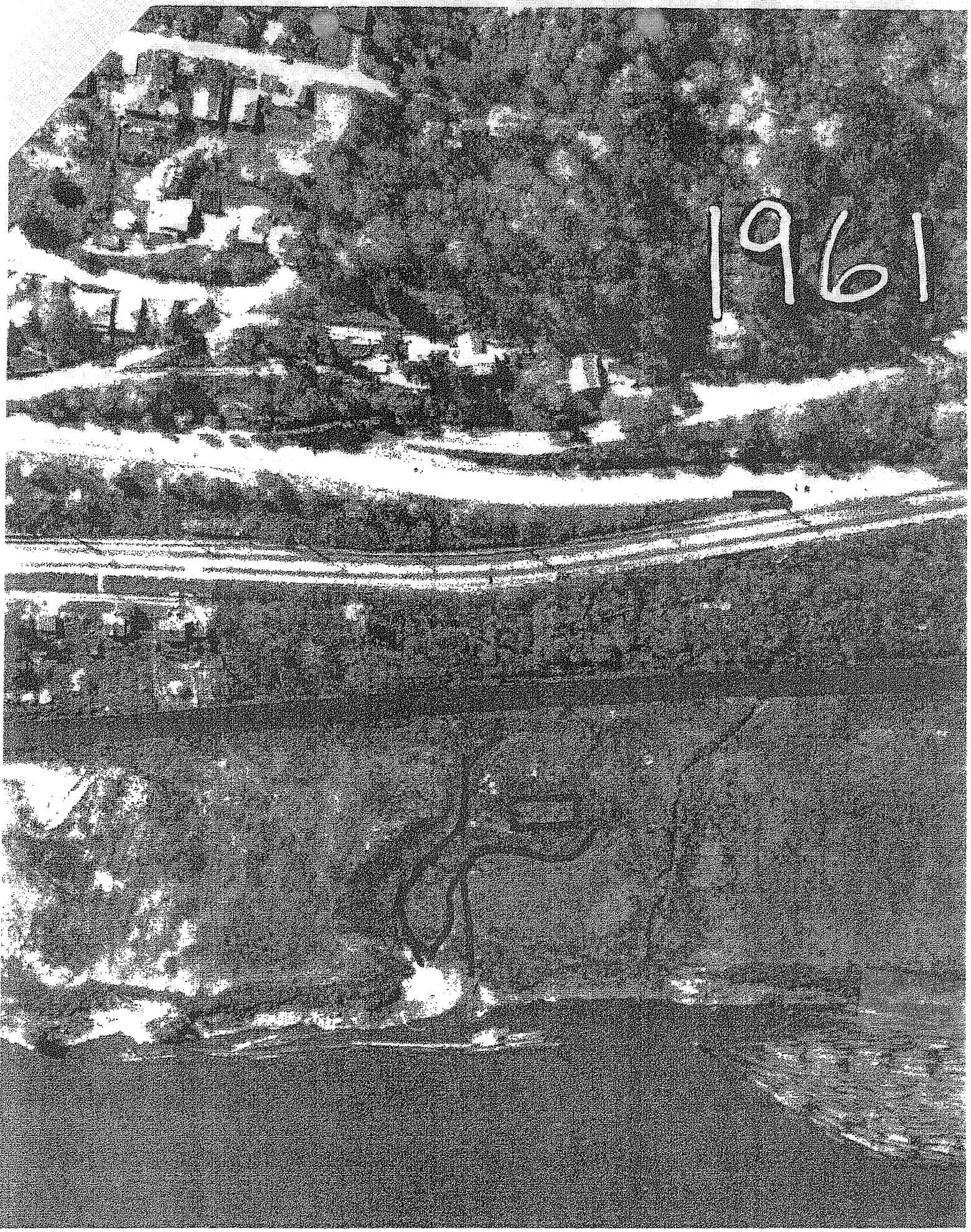
Figure 6
Geologic Profile A-A'
Brix Maritime



ANCHOR ENVIRONMENTAL, L.L.C.

Figure 6
Petroleum Constituents in Groundwater


1936


1961

SUPPLEMENTAL TABLES

Table 2. Soil Data (Anchor 2003)

Brix Maritime
Portland, Oregon

Analytical Methods and Parameters	Analytical Results mg/kg (ppm)																																				
Boring Number	B-2			B-3		B-4	B-5		B-6		B-7			B-9	B-10	B-11	B-12	B-13	B-14		B-17		B-18		B-19		B-20	B-21									
Sample Depth (feet bgs)	10.5	20.5	25.5	20.5	25.5	20.5	10.5	20.5	10.5	15.5	10.5	15.5	20.5	20.5	20.5	15.5	15.5	10.5	12	24.5	12	23	15.5	24	15.5	21.5	23.0	5.0			18.0			23.0		
Sample Date	4/15/1993			4/15/1993		4/15/1993	4/15/1993		4/15/1993		04/15/93			04/16/93	04/16/93	04/16/93	04/16/93	04/16/93	05/29/01		05/29/01		05/29/01		05/24/01		05/24/01	05/24/01									
Northwest Methods																																					
Gasoline by NW TPH-Gx	ND>20	ND>20	ND>20	ND>20	ND>20	ND>20	ND>20	ND>20	ND>20	ND>20	270	2000	13	ND>20	ND>20	ND>20	ND>20	ND>20		ND>0.704	-	10.9	ND>0.532	1.14	ND>0.500	ND>0.617	ND>0.641	1,370.			ND>0.543			ND>0.667		
Diesel by NW TPH-Dx	ND>50	ND>50	ND>50	ND>50	ND>50	ND>50	ND>50	ND>50	ND>50	ND>50	ND>50	ND>50	-	ND>50	ND>50	ND>50	ND>50	ND>50	ND>21.7	ND>28.2	ND>21.5	ND>22	ND>21.3	ND>24.7	-	ND>24.7	ND>26.0	ND>25.7			-			ND>26.7		
Oil by NW TPH-Dx	ND>100	ND>100	ND>100	ND>100	ND>100	ND>100	ND>100	ND>100	ND>100	ND>100	ND>100	ND>100	-	ND>100	ND>100	ND>100	ND>100	200	ND>54.3	121	ND>53.8	ND>54.9	ND>53.2	ND>61.7	-	ND>61.7	ND>64.9	ND>61.7			-			ND>66.7		
Total Lead by EPA 6010											-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4			-			-		
VOCs by EPA Method 8260B or 8021																																					
Benzene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND>0.00309	-	**5.2**			ND>0.00272			-		
Toluene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND>0.00309	-	ND>0.025			ND>0.00272			-		
Ethylbenzene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND>0.00309	-	23.4			ND>0.00272			-		
Xylenes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND>0.00926	-	134.9			ND>0.00815			-		
Naphthalene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.1			-			-		
MTBE (methyl tert-butyl ether)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND>0.25			-			-		
EDB (1,2-dibromoethane)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND>0.025			-			-		
EDC (1,2-dichloroethane)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND>0.025			-			-		
Isopropylbenzene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.58			-			-		
n-Propylbenzene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.1			-			-		
1,2,4-Trimethylbenzene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	59.8			-			-		
1,3,5-Trimethylbenzene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18.7			-			-		
PAHs by EPA 8270																																					
Naphthalene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-		
Acenaphthylene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-		
Acenaphthene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-		
Dibenzofuran	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-		
Fluorene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-		
Phenanthrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-		
Anthracene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-		
2-Methylnaphthalene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-		
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-		
Pyrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-		
Benzo (a) anthracene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-		
Chrysene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-		
Benzo (b) fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-		
Benzo (k) fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-		
Benzo (a) pyrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-		
Indeno (1,2,3-cd) pyrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-		
Dibenzo (ah) anthracene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-		
Benzo (ghi) perylene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-		

Note:

# = reference level not established
bgs = below ground surface
DEQ = Oregon Department of Environmental Quality
EPA = U.S. Environmental Protection Agency
mg/kg = milligrams/kilogram
- = not analyzed

ND = not detected above detection limit indicated
OAR = Oregon Administrative Rules
PAHs = polynuclear aromatic hydrocarbons
ppm = parts per million
VOCs = volatile organic compounds
Bold and shaded = Concentration in excess of reference level

1 Risk Based Decision Making for the Remediation of Petroleum-Contaminated Sites, Oregon Department of Environmental Quality, September 22, 2003
a. Occupational RBC for Soil Vapor Intrusion into Buildings
b. Construction Worker RBC for Soil Ingestion, Dermal Contact, and Inhilation
c. Occupational RBC for Soil Ingestion, Dermal Contact, and Inhilation

Brix Maritime
Portland, Oregon

Analytical Methods and Parameters	Analytical Results mg/kg (ppm)																											
Boring Number	B-22			B-23	B-24		B-25		B-26			B-27	B-28	B-29		B-30	MW-1	MW-2	MW-4	MW-5		MW-6	MW-7	Lowest RBC [1] Occupational Pathway and Construction Worker Pathways	
Sample Depth (feet bgs)	7.0	15.5	22.0	23.0	23.5	27.0	6.0	12.0	6.0	18.0	22.0	3.0	6.0	15.0	23.0	5.0	15-16.5	10-11.5	10-11.5	5-6.5	15-16.5	22.5-24	24.5-26	25-26.5		
Sample Date	05/24/01			05/24/01	05/25/01		05/25/01		05/25/01			05/25/01	05/25/01	05/26/01		05/24/01	07/18/06	02/12/07	07/18/06	07/18/06	07/18/06	07/18/06	06/19/03	06/19/03		
Northwest Methods																										
Gasoline by NW TPH-Gx	-	61.3	1.31	ND>0.617	ND>0.649	ND>0.758	ND>0.704	ND>0.595	ND>0.568	ND>0.543	ND>0.694	ND>0.562	0.829	ND>0.543	ND>0.617	ND>0.543	-	-	-	-	-	-	ND>6.6	ND>7.2	13000	b
Diesel by NW TPH-Dx	ND>23.5	-	62.6	ND>24.7	ND>26.0	ND>30.3	ND>28.2	ND>23.8	460.	ND>21.7	ND>27.8	468.	560.	ND>21.7	ND>24.7	-	360.	40.	ND>35.0	ND>28	ND>27	96.	ND>34	ND>36	23000	b
Oil by NW TPH-Dx	ND>58.8	-	166.	ND>61.7	ND>64.9	ND>75.8	ND>70.4	ND>59.5	1,360.	ND>54.3	ND>69.4	6,010.	8,330.	ND>54.3	ND>61.7	-	ND>110	ND>130	ND>140	ND>110	ND>110	390.	ND>140	ND>150	40000	b
Total Lead by EPA 6010	-	-	-	-	-	3.28	3.75	-	-	-	-	-	3.03	-	-	5.89	4.2	15.9	21.	5.4	4.	32.5	16.3	12.8	750	b,c
VOCs by EPA Method 8260B o																										
Benzene	-	-	-	-	-	ND>0.005	ND>0.005	-	-	-	-	ND>0.005	ND>0.005	-	-	ND>0.005	ND>0.110	ND>0.00098	ND>0.0068	ND>0.0055	ND>0.0054	ND>0.0075	ND>0.0067	ND>0.0072	1.2	a
Toluene	-	-	-	-	-	ND>0.005	ND>0.005	-	-	-	-	ND>0.005	ND>0.005	-	-	ND>0.005	ND>0.110	ND>0.0011	ND>0.0068	ND>0.0055	ND>0.0054	ND>0.0075	ND>0.0067	ND>0.0072	38000	b
Ethylbenzene	-	-	-	-	-	ND>0.005	ND>0.005	-	-	-	-	ND>0.005	ND>0.005	-	-	ND>0.005	1.	ND>0.00071	ND>0.0068	ND>0.0055	ND>0.0054	2.5	ND>0.0067	ND>0.0072	28000	b
Xylenes	-	-	-	-	-	ND>0.010	ND>0.010	-	-	-	-	ND>0.005	ND>0.010	-	-	ND>0.010	2.04	ND>0.0019	ND>0.0068	ND>0.0055	ND>0.0054	2.733	ND>0.0067	ND>0.0072	19000	b
Naphthalene	-	-	-	-	-	ND>0.050	ND>0.050	-	-	-	-	ND>0.050	ND>0.050	-	-	ND>0.050	64.	ND>0.0011	ND>0.027	ND>0.022	ND>0.022	4.9	ND>0.027	ND>0.029	710	b
MTBE (methyl tert-butyl ether)	-	-	-	-	-	ND>0.010	ND>0.010	-	-	-	-	ND>0.01	ND>0.010	-	-	ND>0.010	ND>0.110	ND>0.00079	ND>0.0068	ND>0.0055	ND>0.0054	ND>0.0075	ND>0.0067	ND>0.0072	35	a
EDB (1,2-dibromoethane)	-	-	-	-	-	ND>0.005	ND>0.005	-	-	-	-	-	ND>0.005	-	-	ND>0.005	ND>0.420	ND>0.00098	ND>0.027	ND>0.022	ND>0.022	ND>0.030	ND>0.0067	ND>0.0072	0.37	a
EDC (1,2-dichloroethane)	-	-	-	-	-	ND>0.005	ND>0.005	-	-	-	-	-	ND>0.005	-	-	ND>0.005	ND>0.110	ND>0.00083	ND>0.0068	ND>0.0055	ND>0.0054	ND>0.0075	ND>0.0067	ND>0.0072	0.56	a
Isopropylbenzene	-	-	-	-	-	ND>0.005	0.013	-	-	-	-	ND>0.005	ND>0.005	-	-	ND>0.005	3.	ND>0.00084	ND>0.0068	ND>0.0055	ND>0.0054	7.	ND>0.027	ND>0.029	24000	b
n-Propylbenzene	-	-	-	-	-	ND>0.005	0.021	-	-	-	-	ND>0.005	ND>0.005	-	-	ND>0.005	18.	ND>0.00089	ND>0.027	ND>0.022	ND>0.022	ND>0.030	ND>0.027	ND>0.029	9300	b
1,2,4-Trimethylbenzene	-	-	-	-	-	ND>0.005	ND>0.005	-	-	-	-	ND>0.005	ND>0.005	-	-	ND>0.005	59.	ND>0.0011	ND>0.027	ND>0.022	ND>0.022	20.	ND>0.027	ND>0.029	840	a
1,3,5-Trimethylbenzene	-	-	-	-	-	ND>0.005	ND>0.005	-	-	-	-	ND>0.005	ND>0.005	-	-	ND>0.005	ND>7.8	ND>0.0047	ND>0.027	ND>0.022	ND>0.022	ND>0.970	ND>0.027	ND>0.029	140	a
PAHs by EPA 8270																										
Naphthalene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22.	0.026	0.041	ND>0.005	ND>0.0048	1.8	0.083	ND>0.005	710	b
Acenaphthylene	-	-	-	-	-	ND>0.050	ND>0.050	-	-	-	-	ND>0.050	ND>0.050	-	-	ND>0.050	ND>0.0048	0.011	0.011	ND>0.005	ND>0.0048	0.038	0.039	ND>0.005	#	
Acenaphthene	-	-	-	-	-	ND>0.050	ND>0.050	-	-	-	-	ND>0.050	ND>0.050	-	-	ND>0.050	0.052	0.011	ND>0.0071	0.052	ND>0.0048	0.038	0.05	ND>0.005	16000	b
Dibenzofuran	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.014	ND>0.005	ND>0.0071	0.011	ND>0.0048	0.017	0.01	ND>0.005	#	
Fluorene	-	-	-	-	-	ND>0.050	ND>0.050	-	-	-	-	ND>0.050	ND>0.050	-	-	ND>0.050	0.11	0.01	0.007	0.053	ND>0.0048	0.051	0.04	ND>0.005	12000	b
Phenanthrene	-	-	-	-	-	ND>0.050	ND>0.050	-	-	-	-	ND>0.050	ND>0.050	-	-	ND>0.050	0.24	0.15	0.055	0.44	0.009	0.49	0.34	0.013	#	
Anthracene	-	-	-	-	-	ND>0.050	ND>0.050	-	-	-	-	ND>0.050	ND>0.050	-	-	ND>0.050	0.059	0.048	0.011	0.054	0.006	0.082	0.088	0.0068	90000	b
2-Methylnaphthalene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24.	0.011	0.008	ND>0.005	ND>0.0048	0.91	0.029	ND>0.005	#	
Fluoranthene	-	-	-	-	-	ND>0.050	ND>0.050	-	-	-	-	ND>0.050	ND>0.050	-	-	ND>0.050	0.12	0.22	0.066	0.078	0.029	0.72	0.5	0.086	8900	b
Pyrene	-	-	-	-	-	ND>0.050	ND>0.050	-	-	-	-	ND>0.050	ND>0.050	-	-	ND>0.050	0.16	0.41	0.083	0.077	0.063	0.85	0.55	0.076	6700	b
Benzo (a) anthracene	-	-	-	-	-	ND>0.050	ND>0.050	-	-	-	-	ND>0.050	ND>0.050	-	-	ND>0.050	0.054	0.12	0.018	0.009	0.016	0.33	0.29	0.063	2.7	c
Chrysene	-	-	-	-	-	ND>0.050	ND>0.050	-	-	-	-	ND>0.050	ND>0.050	-	-	ND>0.050	0.06	0.15	0.029	0.014	0.026	0.56	0.36	0.061	270	c
Benzo (b) fluoranthene	-	-	-	-	-	ND>0.050	ND>0.050	-	-	-	-	ND>0.050	ND>0.050	-	-	ND>0.050	0.032	0.94	0.023	0.012	0.016	0.83	0.19	0.037	2.7	c
Benzo (k) fluoranthene	-	-	-	-	-	ND>0.050	ND>0.050	-	-	-	-	ND>0.050	ND>0.050	-	-	ND>0.050	0.039	0.95	0.02	0.013	0.018	0.65	0.28	0.054	27	c
Benzo (a) pyrene	-	-	-	-	-	ND>0.050	ND>0.050	-	-	-	-	ND>0.050	ND>0.050	-	-	ND>0.050	0.036	0.15	0.034	0.014	0.023	**0.92**	0.44	0.066	0.27	c
Indeno (1,2,3-cd) pyrene	-	-	-	-	-	ND>0.050	ND>0.050	-	-	-	-	ND>0.050	ND>0.050	-	-	ND>0.050	0.03	0.12	0.033	0.021	0.023	2.	0.33	0.04	2.7	c
Dibenzo (ah) anthracene	-	-	-	-	-	ND>0.050	ND>0.050	-	-	-	-	ND>0.050	ND>0.050	-	-	ND>0.050	ND>0.0048	0.13	ND>0.0071	ND>0.005	ND>0.0048	0.15	0.056	0.0091	0.27	c
Benzo (ghi) perylene	-	-	-	-	-	ND>0.050	ND>0.050	-	-	-	-	ND>0.050	ND>0.050	-	-	ND>0.050	0.041	0.12	0.049	0.022	0.025	2.3	0.36	0.034	#	

Note:

# = reference level not established
bgs = below ground surface
DEQ = Oregon Department of Environmental Quality
EPA = U.S. Environmental Protection Agency
mg/kg = milligrams/kilogram
- = not analyzed

ND = not detected above detection limit indicated
OAR = Oregon Administrative Rules
PAHs = polynuclear aromatic hydrocarbons
ppm = parts per million
VOCs = volatile organic compounds
Bold and shaded = Concentration in excess of reference level

1 Risk Based Decision Making for the Remediation of Petroleum-Contaminated Sites, Oregon Department of Environmental Quality, September 22, 2003
a. Occupational RBC for Soil Vapor Intrusion into Buildings
b. Construction Worker RBC for Soil Ingestion, Dermal Contact, and Inhilation
c. Occupational RBC for Soil Ingestion, Dermal Contact, and Inhilation